JUNE, 1916 10 CENTS

The Electrical Experimenter

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the same words in the same tone of voice can make the sound carry farther than if both shouted in different tones. In the same way, wireless receivers have a greatly increased range if both of them are exactly matched in tone. You have less trouble getting "in tune" with the sender and you get the signals much clearer. The long distance records made under these conditions are surprising. That is the way Brandes Wireless Head Sets are made—both receivers closely matched. In addition, they are easily adjustable and yet so rigid, when once adjusted to your comfort, that they never slip nor irritate.

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Wireless Receiver Specialists, Room 814, 32 Union Square, New York, N. Y.

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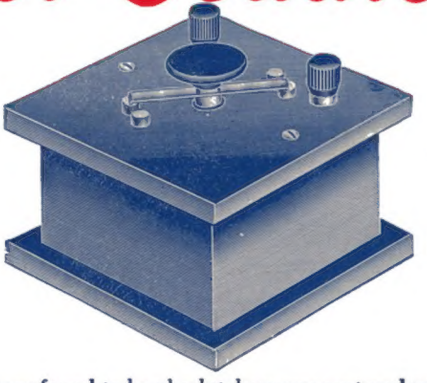
No batteries needed

No operating expense

No set screws or fine adjustments



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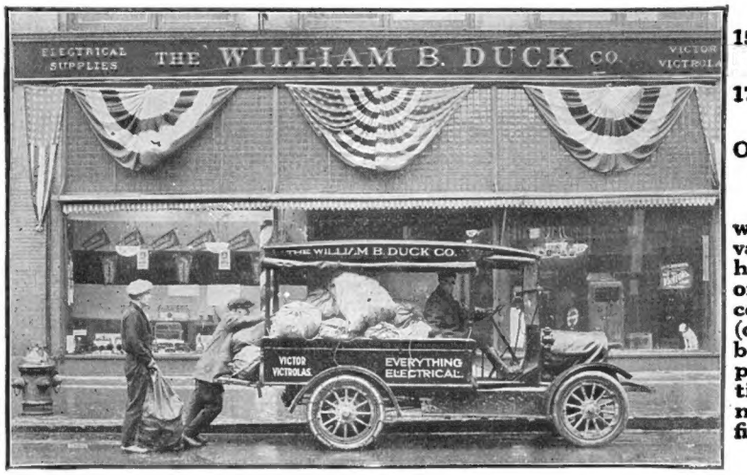

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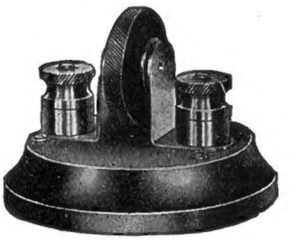

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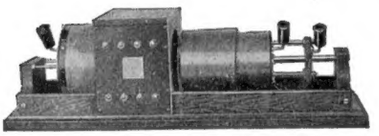

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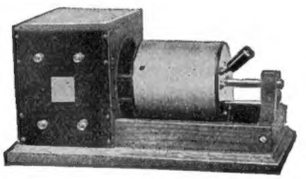
This instrument combines great range with wonderful accuracy and handsome appearance. Highly efficient on undamped waves. Will receive amateur, ship, navy and long wave transatlantic stations with our loading coils below. Range—2,000 meters, size 7" x 7" x 23", finish Mission oak, hard rubber, silver finished coils.

Price.....$20.00



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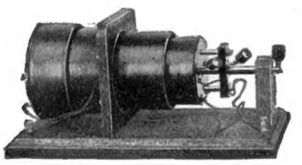


PRECISION VARICOUPLER TYPE AMS

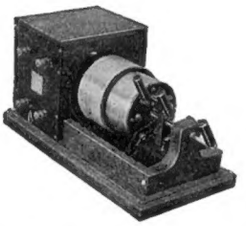
This instrument is similar in size and range to our Type AMM but is designed with a view to making a Precision Varicoupler of wide range and great efficiency as well as handsome appearance at a very low price. This instrument will do extremely fine work and presents a fine appearance on the instrument table. Size 7" x 7" x 23", finish Mission oak, hard rubber, silk covered wire. Range 100 to 600 meters.

Price.....$14.00

ALL Precision apparatus here shown gives you absolutely accurate adjustment without the use of switches or sliders. Precision Varicouplers have no "dead ends," no taps, and can be used without variable condensers. They have a remarkable beauty which appeals to you on sight, and present a fine appearance on your instrument table. Acknowledged by all experts to be the superior tuners.

Important Notice

These prices are good for 30 days only; our former prices have been reduced, in order to universally introduce the present Precision products, as illustrated on this page, within the shortest possible time.



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This tuner is similar to our type AMR but the secondary is not detachable from the primary. Range 100 to 600 meters, designed especially for amateur, commercial and navy work. Finish Mission oak, hard rubber panel and trimmings, silver finished coils, metal parts heavy nickel plate on brass. This instrument is a highly efficient and handsome Precision Varicoupler at a moderate price. Size 7" x 7" x 23".

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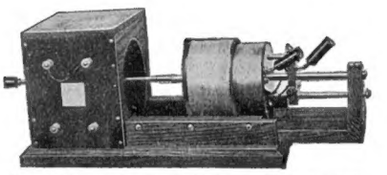
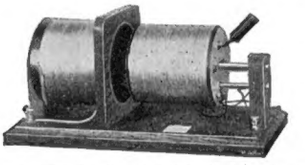


PRECISION VARICOUPLER TYPE AMR

Specially designed for long wave amateur reception on oscillating audion circuits. Extremely loose coupling, wonderfully accurate adjustment high efficiency, handsome appearance. Range 100 to 600 meters. Finish, Mission oak, hard rubber, silver finished coils. With this tuner you can pick up amateurs hundreds of miles away. Size 7" x 7" x 13" closed.

Price.....$20.00



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Same design and range as our Type M, finish Mission oak, hard rubber, silver finished coils. Has greater range than any other variometer at the extremely low price of.....$6.00

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Size 36" x 4½"

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USE THIS SLIP **NOW**

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Gentlemen:

Ship immediatly express collect one Precision Varicoupler, Type N, at your 10-day price of $3.50 for which I enclose money order. If I decide to get one of your de luxe Varicouplers within three months you hereby agree to accept the one ordered now as part payment to the extent of $3.50.

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Address.....

City and State.....

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The Electrical Experimenter

233 Fulton Street, New York.

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Ether

A FISH swimming in the water, his natural element, is not conscious of the fact that he lives in any particular medium. Before you were six years old you did not realize that you lived in a similar medium, the same as does a fish. In this case, however, the medium is air instead of water. Having been born surrounded by air and having lived in air for several years, you never were conscious of the fact that you were walking daily in a gaseous, tho invisible fluid, compressing you with a force of 14.7 pounds on every square inch of your body. Just as the fish does not "feel" the water in which he swims, so we in turn do not realize at once that we are living in a comparatively dense medium also.

Let us remove the water from the lake in which the fish swims. What takes the place of the water? The air, of course. Now let us take away the air, too. What remains? A vacuum, the layman will say. But what is *in* the vacuum? A void? Nothing?

Here the scientist steps in and speaks an emphatic "No."

There can be no such thing as a void. The vacuum is only a vacuum as far as the air is concerned, but the space which contained the air before and which we prefer calling a vacuum is entirely filled with ether.

It is true that we have no sense by which we can detect the presence of the ether, but we know today that it must exist. Nor are proofs lacking. We know that energy cannot be transmitted from one point to another without a medium to conduct it. Thus for example if we place an electric bell under a glass jar we can hear it ring through the glass. If we pump out the air from the glass jar we can no longer hear the bell, for we have taken away the medium—in this case the air—which sound requires to travel thru from one point to another.

Similarly, light requires a medium to travel from one point to another, but what is the medium? It certainly cannot be air, for you can look right through an ordinary incandescent light bulb in which there is a high vacuum. If light were dependent on air, you could manifestly not look thru the bulb, *ergo* the medium is not the air, it must be something else. The medium is the ether, properly called the luminiferous ether. It is an indefinable "fluid," so fine and so impalpable, that our most ingenious instruments have never been able to detect it directly. It fills every inch throughout the universe, it fills the interplanetary space as well as it fills your body. Briefly the ether fills and permeates *everything;* the same as water fills the interstices between the individual grains of a handful of sand. There is this difference however: the water does not fill all of the interior of the sand grains, while the ether does.

We know that ether has no weight, on the other hand we know that it has a certain amount of inertia because time is required for the propagation of its waves—the ether waves traveling at the rate of 186,000 miles per second.

Ether is the modern magic wand of the scientist. By its means our most inexplicable phenomena become at least plausible and can be understood. Thus we know that if we take a minute piece of matter—an atom—and vibrate it rapidly, the ether, which is a sort of weightless jelly, produces certain waves. If we vibrate the atom rapidly enough we produce light. A variation in the speed of the vibrations of a given atom will produce all sorts of manifestations, be they heat waves, light waves or electromagnetic (wireless) waves.

All of these waves are fundamentally one and the same thing; they only appear different due to their atoms vibrating either slower or faster.

It is with these ether vibrations that our scientists will be concerned in the future.

H. GERNSBACK.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. **A green wrapper indicates expiration. No copies sent after expiration.**

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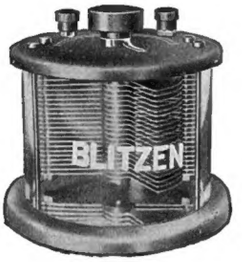

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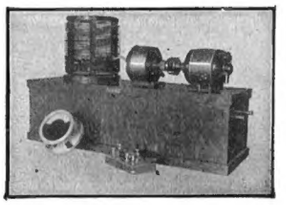

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500 to 600 miles with the "Hytone" Rotary Quenched Spark Set. It is the only high grade transmitter and the only quenched spark gap which will operate satisfactorily on 60 cycle current.

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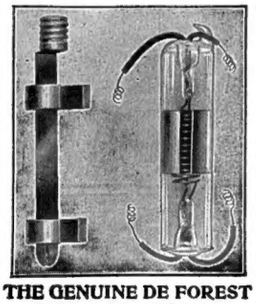

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Is sold separately to any amateur who prefers to build his own Audion Detector **Price $5.50**

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MOST RELIABLE

It is not affected by mechanical vibration nor burned out by static or the transmitting spark. It never fails at the critical moment.

The detector is the heart of the receiving set. Why waste valuable time on an insensitive, unreliable detector?

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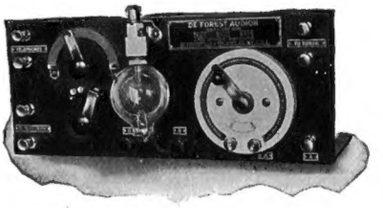

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

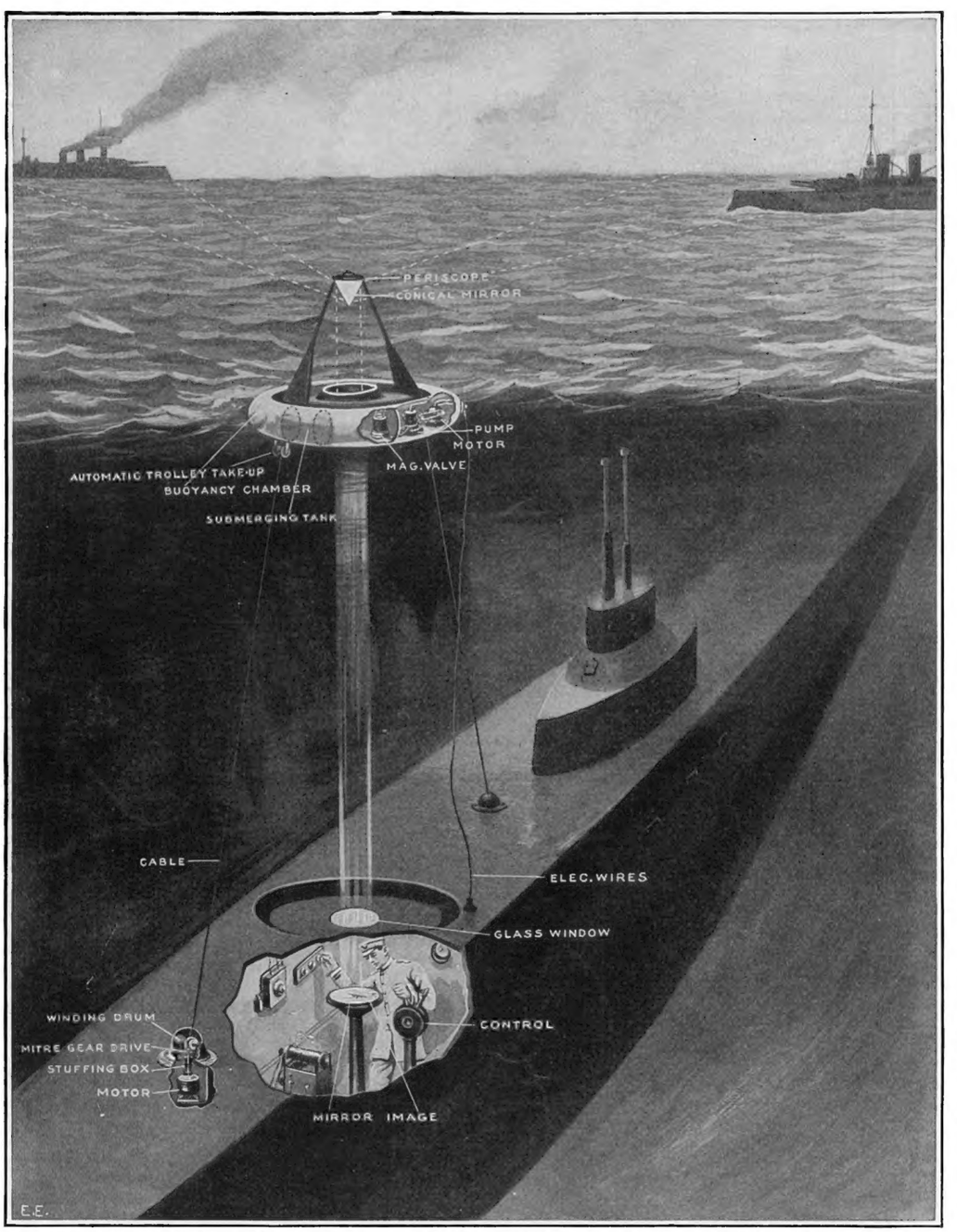
Vol. IV. Whole No. 38 JUNE, 1916 Number 2

An Auxiliary Periscope for Submarines

THE most vulnerable part of the present submarine is its periscope. When running submerged with the periscope below the surface of the water, the submarine is "blind," in other words its commander does not know what goes on above the water. If he is not very cautious he runs two separate risks when rising to the surface. One is that the periscope immediately becomes the target for the enemy's shell fire, if his vessels are near the spot where the submarine rose. The other is that frequently the periscope collides with the hull of another vessel, either enemy or friendly. In both cases the result is disastrous, for, as far as its utility is concerned a "blind" submarine though otherwise intact, ceases to exist for the enemy. Of course, the submersible could scuttle away under the water, without coming to the surface even though its periscope had been shot away. This is known as *running it blind*. However, the difficulty is not that it cannot get away in the manner described, but usually, and possibly in most all cases, there is considerable damage effected aside from that to the periscope.

In other words, it is not the loss of the periscope that endangers the under-sea boat as much as it is the probable damage to the thin steel hull. An extra periscope is undoubtedly available for such contingencies on most foreign submarines. But this is of no avail if the vessel becomes leaky.

With this and other objects in mind Mr. H. Gernsback, of New York City, has devised a separate, *auxiliary periscope* for the use of submarine warcraft. The illustration brings out the idea in detail. There is provided a floating air tank of circular form, on which is mounted a conical mirror. This mirror reflects an image of the entire horizon downward through the water on a second (flat) mirror located within the submarine as the illustration clearly shows. In this way no danger from shell-fire is incurred, as far as the hull of the craft is concerned. If the auxiliary periscope is destroyed by the enemy, the submarine may be navigated submerged or it may remain in the location, venturing upward cautiously after an hour or so, and the usual periscope now comes into play. It is possible also to equip each submarine with this apparatus designed by Mr. Gernsback. The submarine's chances of foiling the enemy are increased a hundred-fold.



Gernsback Auxiliary Periscope for Submarine Use in Reconnoitering. The Image Is Reflected Downward Thru a Glass Window in the Shell of the Submersible.

We may now consider the details of the auxiliary periscope, as proposed. To begin with the floating tank carrying the conical mirror can be submerged, like the submarine itself. This is accomplished by the electric control of a sea-valve installed on the under side of the floating chamber. When opened, it floods a separate compartment with water, causing the device to sink. To make it rise an electrically operated pump, mounted within the buoyancy chamber, is started up. The sea-valve now being closed, the water in the submerging tank is soon pumped out. A check valve in the efflux pipe from the pump prevents the sea-water from backing up into the apparatus.

Attached to the floating mirror pontoon are two wire cables, which may be wound up on suitable drums, driven by electric motors within the submarine hull. These motors operate the cable winding drums through bevel gears; the shafts of the motors passing through water-tight stuffing boxes. To compensate for the rise and fall of the floating pontoon, if so we may term it, owing to a choppy sea, there are provided two automatic cable take-up reels, secured to the upper end of each winding cable. These reels act in a similar manner to those used on trolley cars for automatically taking up the slack in the trolley rope.

In order to haul in or lower the auxiliary periscope to its resting place especially provided at the top of the submarine, the sea-valve, regulated by an electromagnet, is opened to admit water to the submerging chamber, and by operating the electric motors connected to the wire cables the device is pulled downward into its proper place. To release it, the pump motor is started, which, emptying the water tank, renders the pontoon buoyant again. The cable motors are released to permit the auxiliary sighting device to float upward by its own buoyancy.

The circular form of the pontoon and its central orifice tend to give reasonable steadiness unless the sea happened to be very choppy. By squirting oil on the sea the waves may be made to subside appreciably. Most important of all, it does not matter if the float and its conical reflector do bob around slightly, as the sighting accomplished by its aid is only intended for general reconnoissance and *not* for determining the exact range of an enemy vessel so as to torpedo her. Its primary purpose is, therefore, to render an inspection of the sea above the submarine a safer operation than where the usual periscope is utilized for the purpose, as if this happened to be shot away by a nearby warship the chances are that part of the hull plates would be damaged also, and the unlucky crew sent to their eternal resting place—Davy Jones' locker.

RADIO CONTROLLED TORPEDO IN THE MOVIES.

WHAT would we do to-day if a foreign country invaded this land? Our army and navy at present are not very suitable for defensive and offensive work, and the quantity of ammunition which we have to-day is perhaps not sufficient for carrying on actual warfare for any appreciable period. The only way the invader can be checked from entering the country is by employing some defensive means that does not require a large number of trained men. For example the utilization of projectiles that can be fired and controlled at a considerable distance. It is possible to control a torpedo of either the aerial or water type by *wireless,* but although enormous sums of money have been expended by various inventors in an effort to develop a satisfactory radio-controlled torpedo, totally satisfactory results have not been obtained up to this time. In spite of the fact that, although the inventors were not successful in perfecting such a torpedo, a "movie" concern has already produced an elaborate and realistic film showing real aerial torpedoes controlled by wireless. This exciting film, "The Flying Torpedo," was produced by the Triangle Film Corporation. The picture is supposed to illustrate events in 1921, when the United States Government learns of a secret coalition of foreign powers against it. A technical advisory board, composed of the leading American scientists, is organized for the defense of the country. They encourage the invention or contrivances for destruction and defense and offer prizes for the best death-dealing machines developed.

Winthrop Clavering, an alert and ingenious writer of detective stories, reads of the offer and calls the attention of his friend, Bartholomew Thomson, an inventor, to the item. Thomson has previously completed a wireless control mechanism with the financial assistance of Clavering. One of the needs suggested by the board is a *guided* aerial torpedo. Clavering urges Thomson to invent the desired torpedo and provides the necessary funds. Immediately experiments are started by Thomson and William Haverman, his assistant.

After spending a considerable amount of time and money the first experimental torpedo is built and made ready for a trial. It is assembled out in a secret place and the parts are all properly tuned up. Fig. 1 shows the testing arrangement. (In the movies they do it!)

Later the United States is invaded by the foreign hordes, who effect a landing in Southern California. The valiant defense by the navy with the submarine torpedoes controlled by wireless keeps the enemy from our coast on both the Atlantic and Pacific. The invasion of California, however, sets the country in a panic. Clavering and the young inventor lose no time. They co-operate with the Government experts for the manufacture of great quantities of aerial torpedoes provided with *wireless control.* In a short time they are transported to California, and stationed out of range of the enemy's guns. Naval and land battles have been lost repeatedly by the insufficient American forces. Fortresses are demolished and great stretches of territory speedily occupied by the enemy. At a critical moment the new torpedoes are launched by the young inventor and his assistant. Fig. 2 shows a group of soldiers holding the radio-controlled torpedo ready for launching. When the propeller is released by a signal from the inventor (suitably protected at the radio control station. See Fig. 3), the missile darts towards the enemy. An ingenious device is employed in observing the course of the missiles. It is an *electric periscope,* supported by kites, from which connections are brought to an observation apparatus in the operating room. In the illustration at Fig. 3 the operators are using this periscope. In Fig. 4 one of the radio-controlled torpedoes is seen darting downward on the enemy.

According to the pictures, these torpedoes saved the country from the enemy.

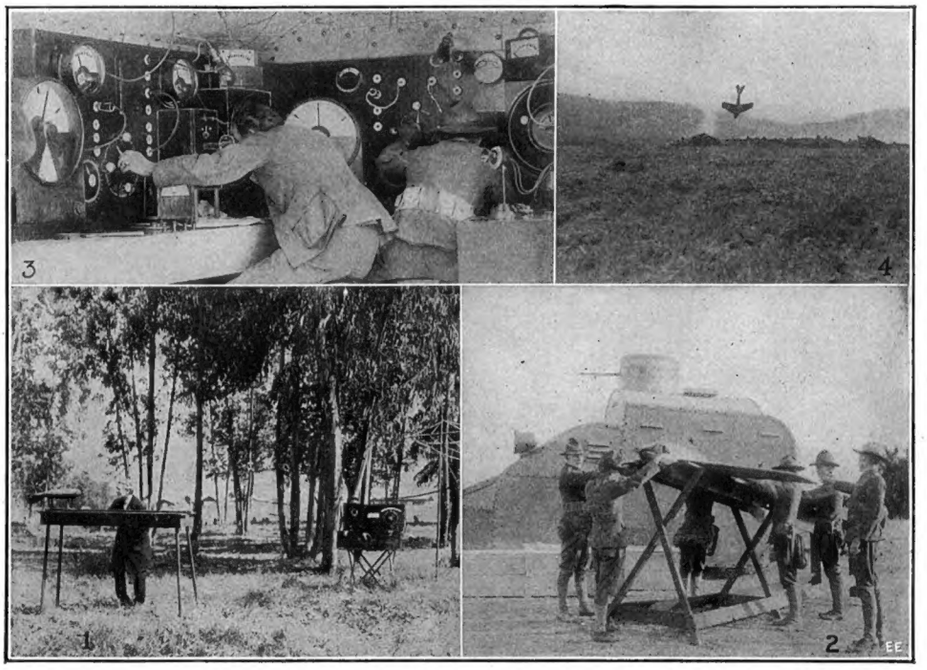


Fig. 1. How the Inventor in the "Movies" Develops a Radio-Controlled Torpedo. Fig. 2. One of the Aerial Torpedoes Ready for Launching. Fig. 3. Interior of Control Station. Fig. 4. The Radio Torpedo Destroying the Enemy.

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain The Electrical Experimenter, we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

Electricity and the Weather Man

By Samuel Cohen

"WHAT will be the weather to-morrow?" is the continuous question asked by millions of people all over the country, and this is most accurately answered by the Government weather forecaster.

One can not imagine offhand perhaps the important rôle electricity plays in operating the various delicate weather recording instruments. However, it would be nearly impossible for the Weather Bureau to operate successfully the different sub-stations if electricity was not employed. Practically every conceivable instrument used by the bureau is operated by electricity.

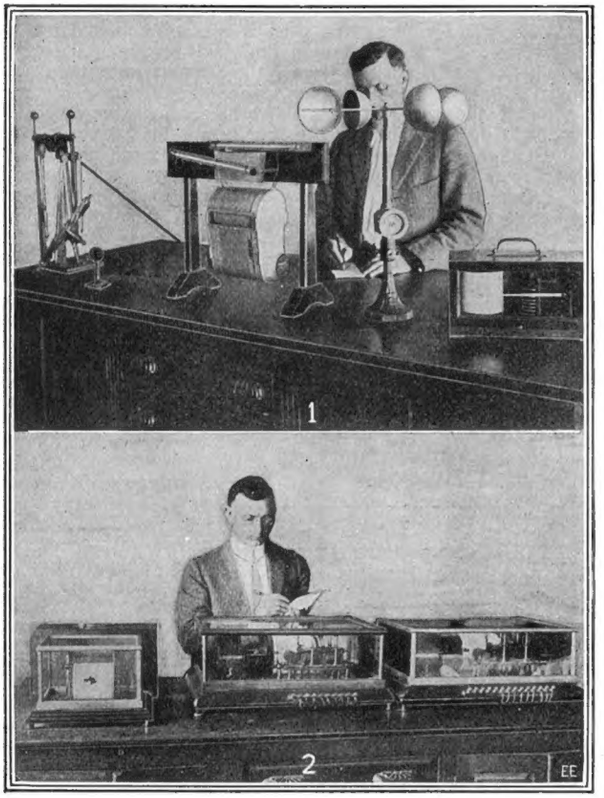


Fig. 1 (Top):—At the Extreme Left are the Dry and Wet Bulb Thermometers for Finding the Humidity of the Air. Because of Varying Rates of Evaporation of Moisture from the Wet Bulb Thermometer with Consequent False Readings, the Instruments are Whirled Rapidly when the Record is Taken. Next Comes the Sunshine Gauge Which Records in the Office Below, Exactly the Duration of Sunshine. Next is the Minimum (top) and Maximum (bottom) Thermometers, That Give the Lowest and Highest Temperature Each Day. Below is a Kite Meteorograph Used for Recording Conditions of the Upper Atmosphere, When it is Sent Up on a Kite. Next to the Right is the Anemometer or Wind Gauge. At the Extreme Right is Shown the Barograph Which Records the Continuous Barometric Pressure.

Fig. 2 (below):—The Instrument at the Left Gives a Continuous Record of the Weighing Rain and Snow Gauge. Next is the Triple Register or Station Meteorograph, Which Records the Action of the Wind Vane, the Anemometer (wind velocity), the Sunshine Gauge, and the Rainfall as Told by the Tipping Bucket Gauge, All of Which Instruments are on the Roof Above.

Some of the most important weather forecasting instruments are shown in Fig. 1. These are placed outdoors (on the roof) and the electrical connections of each are brought separately to the recording instruments, which are shown in Fig. 2. Coming back to the outdoor instruments, at the extreme left of the photo are *dry* and *wet* bulb thermometers used for determining the humidity or the amount of moisture in the air. Because of the varying rates of evaporation of moisture from the wet bulb thermometer, which would tend to give a false reading, the instruments are whirled rapidly when the record is taken, so that the evaporation is always at the fastest rate possible.

The glass tube, set at an angle, next to the humidity instruments is a sunshine gauge, an ingenious instrument that records exactly the duration of sunshine. This apparatus consists of two tubes, one of which is placed inside the other. The outer tube is partly exhausted. The inner one is made similar to a dumb-bell, but instead of having globes on the end, it has cylinders. The lower one is coated with lamp black to absorb the sun's heat. The lower tube is filled with mercury to about three-eights its capacity, while the upper one contains alcohol used for lubricating this mercury. The center portion of the tube contains two sealed-in platinum wires, which are connected to the recording instrument. Now it is evident that whenever the sun shines on the sooted portion of the tube the absorbed heat will expand the air in the bulb and thus cause the mercury to rise. As soon as it rises to a certain height it will short-circuit the two sealed-in platinum wires and thus complete the recording circuit.

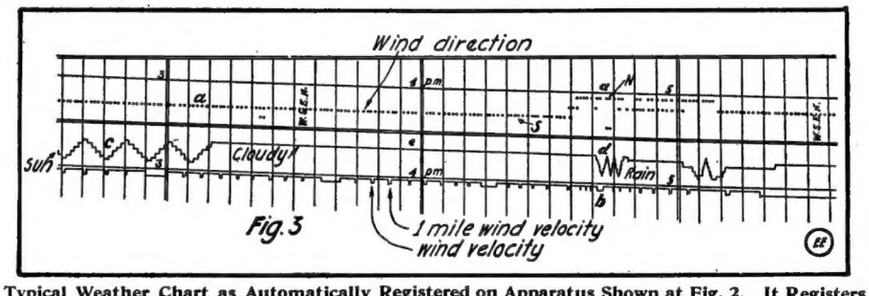
The two thermometers on the stand at the center comprise a minimum (top) and a maximum (bottom) thermometer, which indicate the lowest and highest temperature each day. Underneath is a kite meteorograph, used for recording conditions of the upper atmosphere. The velocity of the wind is measured by an anemometer; this is perceived standing at the right of the kite meteorograph. It consists of four aluminum buckets set at right angles to each other and supported by a suitable frame. The cups when revolved by the wind cause the rod, which is enclosed in the tubular upright, to operate a gear arrangement placed in the lower portion of the instrument. The gear is so made that whenever the buckets revolve at a speed of 500 times per minute a centrifugal device makes contact with an electric terminal which is connected to the recording instrument. It is, therefore, obvious that the number of turns of the cups per minute determine the velocity of the wind. The greater the velocity of the wind, the more times the recording circuit will be made and thus in turn the recorder will make its record faster.

At the extreme right is shown the barograph, an instrument which records the continuous barometric pressure.

The rain and snow gauges are not shown in the illustrations but are also important instruments to the weather man, as they determine the amount of rain and snow that fall during a certain period of the day. The rain gauge consists of a circular chamber, covered with a funnel which leads to a double bucket, delicately supported. A spring contact is so placed underneath the bucket that whatever bucket falls, it will depress this spring which touches another electric terminal connected to the recording instrument. The buckets are so adjusted that one-hundredth of an inch of rain will upset the equilibrium of the bucket, thus causing it to fall and in so doing complete the recording circuit. It is thus quite clear how the weather man is enabled to determine exactly the amount of rain that falls each day.

In determining the amount of snow that falls during a certain period, a unique machine is used which consists of a copper pan placed upon a special scale. The scale is so adjusted that one-hundredth of an inch of snow will upset it and in so doing causes two terminals to touch, which are connected to the recording instrument. An arrangement is placed on the scale whereby the balance is set to the zero position when additional snow falls into the copper pan. This consists of a weight placed on the scale lever which is automatically shifted on the scale lever by a ratchet operated by an electromagnet when the depression of the pan closes the circuit. Thus an accurate reading can be obtained by the use of this snow recording instrument.

The recording instruments (Fig. 2) are placed indoors. The instrument at the left gives a continuous record of the rain and snow gauge. Next is the triple register or station meteorograph which records the action of the wind vane, the anemometer (wind velocity), the sunshine gauge and the tipping bucket gauge. The recorder itself consists of a drum carrying a paper chart upon which different records are made. The drum is revolved by a spring motor. Ink pens, controlled by electromagnets, are actuated by the various outdoor instruments. A portion of an actual record taken by the triple register or station meteorograph is given in Fig. 3. The record of the wind direction appears at aa. The velocity of the wind is shown by the lateral deflection of the velocity record at b. Each ten miles is marked by a relatively broad deflection. Duration of sunshine is recorded by the zigzag trace at c; rainfall, by the line d. The line e indicates cloudiness or the absence of either rainfall or sunshine.



Typical Weather Chart as Automatically Registered on Apparatus Shown at Fig. 2. It Registers Wind, Direction and Velocity, Rain, and Sunshine.

When New York City Turns On the "Juice"

By H. Winfield Secor.

WHEN the average New Yorker turns on his electric lights or power motor, he possibly does not stop to think once in a thousand times as to what effect this small quota of electrical energy has on the gross amount used in the entire city of Greater New York with a population of over 5,000,000 people. Again it is just as possible that he does not stop to think once in ten thousand times as to the effect of turning on the electric lights at any certain time of the day or night. The graphic curve, as it is termed among engineers and illustrated herewith, shows how the demand for electrical energy both for illumination and power consumption varies during the complete cycle of twenty-four hours, starting in this particular instance at midnight of Sunday, December twelfth, and ending at midnight Monday, December thirteenth. This curve covers the combined total daily output of both the New York Edison Company and the United Electric Light & Power Company. The two corporations supply all of the electrical load for the metropolis exclusive of subway, surface and elevated train requirements which are cared for by private central stations owned by the companies operating these traction systems.

Starting at midnight, as indicated by the point on the curve at the extreme left, we see that the total motor and illumination load of the entire city was about 65,000 K.W. (kilowatt equivalent to 1⅓ H.P.). As the wee small hours of the morning progress, the demand falls off until it reaches the lowest point of the whole cycle of twenty-four hours with a kilowattage of 37,000. This ebb tide point starts to move upward, as observed, after four in the morning, or about the time the milkman begins to make his rounds and when a considerable portion of the city's working people have risen, and for the time of year here under consideration the fairly rapid increase of energy consumption from this point on to seven o'clock is due to the great demand for electric lights during the breakfast period.

A great many of the large manufacturing establishments and factories start work at 7 a.m. or at least by 8 a.m., and the load curve goes shooting skyward at a rapid rate as the illustration depicts. Now the thousands of office employees are arriving and the elevators in the towering skyscrapers of the greatest city in the world are taxed to capacity. These require a larger amount of energy than is popularly imagined and consume no small part of the total load component for the day.

The central and sub-stations scattered about the city have been the scene of great activity during these hours of increasing demand for current in one form or another, and dynamo after dynamo has had to be switched on to the city's feeder lines in order to care for the enormous demand now created. Just before the noon hour arrives, the maximum peak for the morning load has occurred. The maximum total output at this period of the day has reached 166,000 K.W. The curve starts to fall away at this period just before reaching twelve, presumably due to the fact that the many thousands of factory employees have started to wash their hands preparatory to assimilating their noon repast, and directly after twelve the curve makes a decided drop of *33,000 K.W. in thirty minutes.*

As many of the manufacturing establishments have from one-half to three-quarters of an hour nooning, the load curve begins to crawl skyward again and shortly after 1 p.m. it has attained the same value as that existing before the noon drop.

As perceived the afternoon load reaches a much higher value than the maximum demand during the morning hours. Now the theatres have started to open their doors and contrary to the olden days in the greatest theater city on earth, most of the playhouses now run matinees owing to the great spread of the moving picture craze. The theaters are one of the greatest consumers of electrical power, both directly and indirectly, in Greater New York. The afternoon section of the curve fluctuates through a value of about 10,000 K.W. until at 4 p.m. it starts on its last steady rise.

Considering the time of year this rapid increase of the curve is to be looked for, as the afternoon and early evening are quite dark. Now all the various manufacturing establishments, stores and restaurants are in full swing together and the final "peak" of the twenty-four hours' load is reached at 5 p.m. This is the most critical moment of the whole day's performance at the central and subsidiary stations; every dynamo is humming to full capacity and every conceivable form of activity is going on in the city. The office and factory workers are homeward bound, the thousands of elevators in public and private buildings are scuttling earthward with their human freight. The restaurants are full to overflowing with dinner crowds and not to mention the thousands of electric lights being switched on in private residences and apartment houses throughout the metropolis.

The maximum peak of the load carries itself well for about one-half hour, when it begins to take a decided slump. In one hour's time there has been a decrease in the maximum demand for electrical energy of 30,000 K.W. As may be imagined this has required some very clever maneuvering on the part of central station operatives and those in charge. As the load falls off, some of the dynamos are shut down and the sky-rocketing load curve has started on its last downward path, never to reach the peak value of 235,500 K.W. again until the morrow.

There continues a brisk demand for electric current, as witnessed by the appearance of the curve, and it hangs grimly in its slow but sure downward movement. At night time is when the 5,000,000 New Yorkers enjoy themselves. Generally a large majority, of course, visit the theaters. These, as well as the hotels, are the leading factors in the evening load component. Broadway's millions of scintillating lights and its thousands of huge signs atop the buildings also consume a respectable amount of current. Even after 10 p.m. the curve drops very doggedly and keeps up a fairly decent appearance up to its starting point, or midnight.

New York is probably the gayest city in the world, not even excluding Paris, and the after-theater supper crowd manages to keep the central stations busy by their demand for illumination in the restaurants

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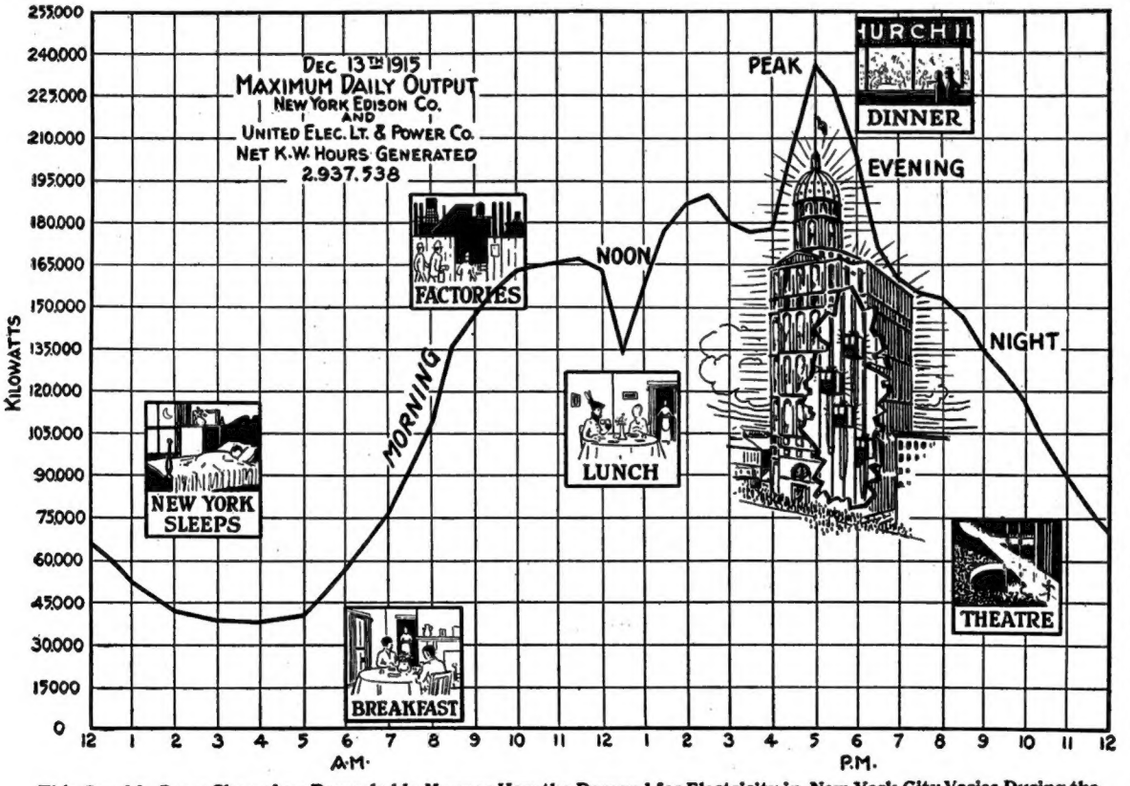


This Graphic Curve Shows in a Remarkable Manner How the Demand for Electricity in New York City Varies During the Twenty-four Hours. First the Factories, Then the Theatre Matinees, Business Offices, Elevators, Electric Signs and Restaurants Help to Boom the Demand for "More Juice."

Electricity and Wireless Solve Secret Service Problems

THE illustrations herewith give several views of a Western Secret Service Bureau. This bureau has been extraordinarily active in quickly adapting the latest advances in electricity and wireless to their various needs and requirements. They handle a great many different cases, including murder, arson, burglary and robbery and, therefore, have every opportunity to make use of any scientific aids which may be available.

The exact degree to which an individual may jolt up against the air of mystery that pervades the Bureau's offices may be best described in showing what a suspect would encounter were he taken to the rooms by an officer.

With the door opened half way he is startled by a hissing flash, partly concealed and he does not realize the fact that his photo is being taken. After this he is seated in another office and his photo taken front and profile, his finger marks recorded, every word he says recorded automatically without his knowing it, and his very footsteps on the rug are made part of another record. If he grows fussy over something and attempts to escape he will find every avenue for escape cut off and he will not be able to do much aside from sitting down again, as the various cabinets, brilliant flashing, buzzing and spitting from the numerous electrical appliances in the rooms create an atmosphere of mysticism and uncertainty that will work pretty definitely on the mind of an individual who has transgressed the law and who is aware of the fact that every move he makes, every word he says, the exact shading of his voice, the peculiar nervousness he manifests, the character of his walk, and all other personal characteristics are becoming part of a permanent filing system that will check him up anywhere in the country.

In the general private 'phone system, which has recorders and transmitters so delicate that one does not have to employ the usual ear trumpets or the like, the office has already been connected up with a number of institutions necessary and the service is in perfect working order.

Referring to the illustrations, Fig. 1 depicts the wireless "Revelarophone" switchboard and this is so constructed that with the few switches shown it is possible to operate over ten distinct apparata. Fig. 2 shows the secretary's office in which is installed the "Revelarograph," an instrument that makes a permanent record of all speech taking place on all incoming or outgoing telephone messages, and also verbal conversations that occur in any of the offices. It is claimed that it does almost everything but think. Besides there is a special photographic apparatus mounted in one of the cabinets which will snap a man's physiognomy in three different positions without any attention whatsoever. By means of the lately perfected and marvelously sensitive detectaphones here used it is possible for a person standing in the secretary's office to hear everything going on in any of the other offices, without the use of a receiver or without straining one's ears to catch even a whisper, the reproduced voice emanating loud and clear from the receiver of the instrument. The apparatus may be adjusted to any degree of sensitivity. The chief electrician, Mr. L. S. May, of the Bureau's scientific staff, has also evolved an electrically operated Bertillon photographic apparatus and a wireless telephone of the portable type, which may be carried about in a suitcase. The inventor is observed busily engaged in his private laboratory at Fig. 3. Thus does science slowly reduce the activities and artifices of the underworld.

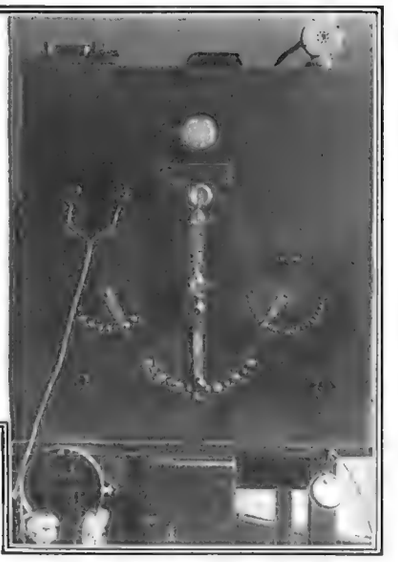


Fig. 1: The Wireless "Revelarophone" Switch-Board Used to Good Advantage in Western Detective Office.

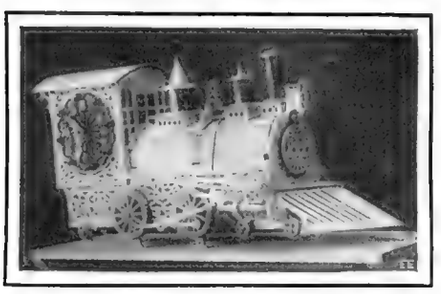
Fig. 2: The Cabinets Here Observed Contain Automatic Voice Recorders as Well as Triple Photographic Apparatus.

Fig. 3: Mr. L. S. May, Chief Electrician of the Secret Service Bureau, in His Private Laboratory.

ELECTRIC CLOCK RESEMBLES LOCOMOTIVE.

A Kansas mechanic has constructed an electric clock in the shape of a locomotive. It is 30 inches long, 13 inches high and 8 inches wide, weighing 9 pounds and 11 ounces. It required nearly eight months to complete this unique model, including the work of wiring and mounting of the thirteen electric lamps. A manual switch controls the wiring system in twelve different ways and combinations. The clock automatically turns on the current at six o'clock in the evening and turns it off twelve hours later. Separate circuits are arranged for the headlight, lamps on the face of the clock and those in the cab. The various lights are flashed on about every fifteen seconds for a duration of three seconds. The dial is of imitation ebony and is studded with tiny ruby and green incandescent lamps. This clock is of the eight-day type and strikes on the hour and half hour by ringing the engine bell. When this is done the driving wheels rotate.

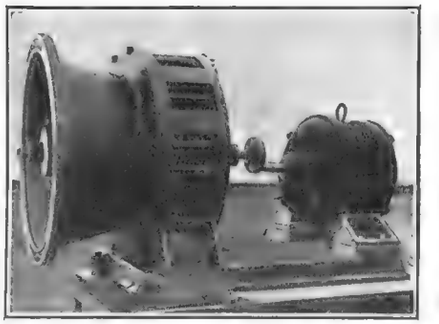
Contributed by H. E. ZIMMERMAN.



Unique Electric Clock in Form of Locomotive.

ELECTRIC SIREN HEARD FOR MILES.

The motor-driven siren of extra large size here illustrated was used as an attraction and also for fog signal work during the recent Panama-Pacific Exposition at San Francisco, Cal. The motor is of the alternating current induction type. The siren or sound producer is direct coupled through an offset crank or coupling. It is said that the one shown here is the largest motor-operated siren ever constructed. It was installed on the roof of one of the Exposition buildings. The piercing and extremely powerful note emitted by this noise producer could be heard ten miles out at sea. This form of electrically operated sound generating device is also available in small and medium sizes which have proven of extreme efficiency for many different requirements such as fog signaling, factory alarms and time signals and the like.



Electric Siren Which Can Be Heard Ten Miles.

WHEN EDISON TAKES LUNCHEON.

The general public is always more or less interested, to an unimaginable degree, in the daily habits and hobbies of those whom the gods have chosen as their most famous sons. The illustration herewith depicts the well-known inventor, Mr. Thomas A. Edison, just finishing luncheon at his home in Llewellyn Park, Orange, N.J. Mr. Edison is a light eater always, but he believes in the best of everything and three meals a day, except when engaged in some lengthy experiments, in which event he frequently forgets to eat for many hours at a stretch.

Talking about habits of "the powers that be," an interesting anecdote is related about Mr. Edison and a box of those justly famous, or rather "infamous," Perfectos with which our wives and sweethearts are wont to bombard us at the Yuletide season. One of his particular friends presented him with a box of what was supposed to be pure Havanas, but which on their first "laboratory test" proved somewhat otherwise. It is said that the cigars were placed on a shelf out of the way, presumably for presentation to some of the many unwanted visitors to the laboratory. Directly, however, the great inventor became so engrossed in deep research work on which he was engaged, that he managed to dispose of every one of those Perfectos. Absent-mindedness is one of the attributes of all the great men it seems, but if some of us didn't concentrate our minds the patent office would go bankrupt.

Photo Copyright by Janet M. Cummings.

Thomas A. Edison, the Veteran Inventor Taking Luncheon at His Home in Llewellyn Park, N. J.

A MOTOR-DRIVEN RIDDLE FOR FOUNDRIES.

A motor-driven gyratory riddle for use in foundries is one of the latest devices designed for boosting efficiency in the great iron and steel plants. It is said that this machine will sift sand faster than one man can shovel it in, and moreover it sifts it better and more thoroughly than can be done by manual labor. Again it is stated that this machine will sift more sand in a day than 10 men. This riddle not only sifts the sand, but mixes it as well, thus saving one turning of the sand. Evenly mixed and tempered sand not only reduces the time of making the mold, but insures a much better mold, necessitating fewer patches after the pattern is made, thus increasing the output of each foundryman, besides making the casting truer to the pattern.

New Motor Driven Riddle for Foundry Work, a Great Time Saver.

The device as here observed may be run about the foundry on a trolley cable. Its motor, being of a small size, may have its service connection plug inserted in any near-by lamp socket. The motor develops 1/6 h.p., and hence is very economical in the use of current. The sieve is 20 inches in diameter, and is held in place by an improved clamping device, which enables the operator to remove the sieve, dump and replace it in less time than it takes to tell about it. The design is very simple indeed, and no gears or other complicated or dangerous moving parts are incorporated. Moreover, there are but three bearings to be oiled and cared for. All parts are made of metal, thus insuring the longest life possible to the device.

NAVY RADIO BRINGS WIFE MONEY FROM HUBBY.

A new application of wireless has been found by the Navy Department. When Mrs. Nellie G. Shippee complained that she was in want, a message was sent from the Brooklyn Navy Yard to the battleship "Wyoming," at target practice off Guantanamo, Cuba, telling Earl W. Shippee, chief electrician, that he must send money to her. Shippee sent his wife a money order.

A MOTROLA FOR YOUR VICTROLA.

The Motrola, as it is called by its sponsors, is nothing more nor less than a very neatly contrived electric motor and driving gear attachable to any type of talking machine for either disc or cylinder records. On the axle of the motor is a worm-gear that operates a wheel and this latter in turn is fastened to the winding rod of the talking machine mechanism.

When connected with the electric current by virtue of the attachment plug supplied with same and inserted in any lamp socket, the Motrola winds up the talking machine to about three-quarters of the capacity of the spring, then the current is automatically cut off. When the machine runs down to about one-half the spring's resistance capacity, the current is automatically turned on again. Thus it is claimed that this device tends to keep the spring of the machine motor constantly wound between one-half and three-quarters of its full strength—which is the strength required to give even time and true tones. One particularly good feature about this attachment is that should the electric current fail at any time, the device may be removed very quickly and the winding crank for the spring motor reattached.

The "Motrola" Electric Motor Drive for Talking Machines.

CHARLES AUGUSTIN COULOMB.

June, 1916, Marks His 180th Birthday. Born, June 14, 1736—Died Aug. 23, 1806.

CHARLES AUGUSTIN COULOMB was born at Angoulème, France, June 14, 1736, and died at Paris, August 23, 1806. Coulomb belonged to a noble family of Montpelier. He chose the profession of military engineering. In 1773 he gained great distinction by his statistical problems applied to architecture, which he presented to the Academy of Science in 1778. He shared with Van Swinden the prize for improvements in the construction of compasses. In 1771 he was stationed permanently at Paris, and was appointed inspector of public instruction in 1802, but he was not strong enough for the work and four years later he died. He had the rank of lieutenant colonel of engineers. His fame rests chiefly on his most elaborate and important investigations in electricity and magnetism, and on his invention of the torsion balance in 1777. This instrument is still used universally in all elaborate research work, particularly in measurements of electrical and magnetic actions. Coulomb proved by a series of extensive experiments, that, contrary to the general accepted theories of Cavendish, electro-static electricity, like gravity, varies inversely as the square of the distance. Adopting the two-fluid hypothesis, Coulomb investigated the distribution of electricity on the surface of bodies. His experiments on the dissipation of electricity are of considerable value. He found that a thread of gum-lac was the most perfect of all insulators; it was ten times better an insulator than a dry silk thread. He ascertained that a silk thread covered with fine sealing wax insulated as effectually as gum-lac, when it had four times its length. Considerable study on his part proved that the dissipation of electricity along insulators was chiefly due to adhering moisture, but in some measure also to a slight conducting power. His writings were collected by the Société de Physique, and a great part of the matter was obtained thru the courtesy of Monsieur Potier from his volume 1 of the "Memoirs Relating to Physics."

The Paris Electrical Congress of 1881 adopted the name of Coulomb as the practical unit of electrical quantity. The coulomb is equal to 10^{-1} of the C.G.S. unit of quantity.

WIRELESS AIDS RAISING OF FUNDS FOR BOYS' CLUBHOUSE.

While a campaign was being recently carried on to raise $125,000 for the erection of a clubhouse, in Charlestown, Mass., wireless played an important rôle. On Sunday, March nineteenth last, at 2 p.m., a radiogram asking help from all amateurs was sent out from the powerful radio station at Tufts College. As a result many amateurs and Boy Scout organizations appeared with contributions which they had collected. The $125,000 was collected in ten days and the club-house will be under construction in a few months. The new club, when completed, will have classes of instruction in wireless telegraphy, wire telegraphy, electricity, engineering, mechanical drawing and many other trades. There will also be a first-class radio sending and receiving station. This organization has twice outgrown its quarters and is forced by lack of space to move to a larger building. At the present time there is a class in wireless telegraphy. Out of twelve boys, eight have passed the Government examination and obtained their license. They all have sending and receiving stations.

Bronze Tablets Mark the Birth-place of the Telephone

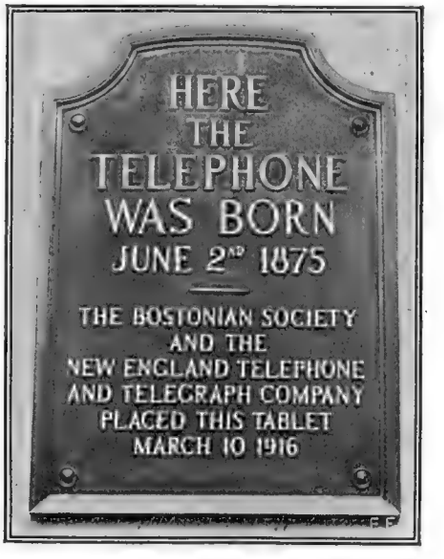
March thirteenth last was a red-letter day in the annals of the city of Boston, when the fortieth birthday of the telephone was celebrated by the Bostonian Society, the Boston City Club and the Telephone Company, assisted by the inventor, Mr. Alexander Graham Bell. Professor Bell was the guest, during his stay in Boston, of the Boston City Club and, accompanied by Mrs. Bell, participated in the unveiling of two bronze tablets placed by the Bostonian Society and the Telephone Company upon the two sites made memorable in the first experiments of Professor Bell.

UNVEILING OF THE TABLET ON 5 EXETER PLACE, BOSTON.
In the Foreground are the Following: Vice-president E. K. Hall of the New England Telephone and Telegraph Co., Professor Alexander Graham Bell, Mrs. Bell, Vice-president W. T. A .Fitzgerald of the Boston City Club.

On a column of a porch of the building, 109 Court Street (now known as the Palace Theater), where, on the top floor, Thomas A. Watson heard the first sound ever sent over a telephone wire, the permanent record "Here the telephone was born June 2, 1875," was placed in bronze. Until Professor Bell unveiled the bronze tablet it was draped and obscured by an American flag.

Professor Bell spoke of his regret over the absence of Mr. Watson (who was in Florida) in his response to the presentation speech by Courtenay Guild of the Bostonian Society and also briefly acknowledged the honor of being present on these auspicious occasions.

A short time elapsed between that unveiling and the arrival of the official party at No. 5 Exeter Place, where, on the wall of the building now occupying the site where Mr. Watson heard the first connected speech over a telephone wire (Professor Bell's "Mr. Watson, Mr. Watson, I want you. Come here"), a bronze tablet was placed, reading "Here Alexander Graham Bell transmitted to Thomas Augustus Watson the first complete and intelligent sentence by telephone, March 10, 1876."



The Bronze Tablet, Commemorating the Birthplace of the Telephone. Erected at 109 Court St., Boston.

Professor Bell, himself, removed the American flag from that tablet, completing the recording of those two historic events.

ELECTRICITY SAVES "BUBBLES" IN BOTTLING CHAMPAGNES.

In the aging and clearing of wines electricity plays a most important part. As may not be generally known, considerable sediment forms in the process of aging wines made from the grape.

In the case of still wines the process can be carried on in casks and the clear wine decanted off, but in the sparkling wines the treatment must be done in bottles. This involved not only considerable skill in handling, but there was often loss of "bubbles."

This is now all changed. The bottles are placed in racks neck down and, at various stages of aging, they are transferred to electrical refrigerating machines, which freeze the dense liquid next to the cork. This is then scraped out and the cork replaced. A better product at far less cost is thus secured.

AMONG the hundreds of new devices and appliances published monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnished to you, free of charge, by addressing our Technical Information Bureau.

Wireless Music With Your Meals

By ALBERT MARPLE

There is a new "fad" in Southern California, the place where novelties grow over night like the proverbial mushroom. This time the "something new" comes in the form of phonograph concerts by wireless. Sometimes they come in at the noon hour, at others while dinner is being served and again perhaps in the quiet of the evening, while the family is gathered around the hearth. However, when they do occur they do so unannounced, this fact making them all the more welcome. This "music by wireless" idea is one of the most recent electrical inventions of Earl C. Hanson, a young California radio expert. In a word this new "fad" consists of phonograph music being transmitted by wireless from the home of the inventor to the dwellings of a number of friends and neighbors residing within a mile or so of the Hanson residence. This music is sent to all of the homes simultaneously and with no effort on the part of those at the receiving ends of the "line." To show that his invention was a "workable" one young Hanson gave a series of concerts recently and the work of the system was pronounced wonderful.

Left Hand Photo Shows Radiophone Loud Speaking Receptor on Dining Table. Lower Picture Depicts Loud Talking 'Phone on Table.

During the past several years Mr. Hanson has been working on a new type of wireless telephone and it is with the assistance of this apparatus which he has recently perfected to a high degree that these wireless concerts are made possible. The telephone shown in one of the illustrations accompanying this story is used as a central station, being located in the experimenting room of the Hanson residence. Upon the roof of his home this inventor has erected an elaborate aerial and this was used for transmitting, while the receiving stations are located, some within and some outside the homes selected for the concerts.

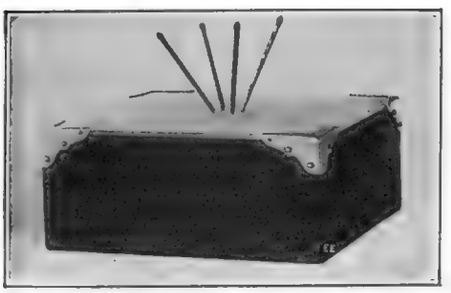
Top View: Wireless Telephone Enthusiast, Mr. Earl C. Hanson. Right Hand Photo: Victrola, Microphones and Radiophone Transmitting Apparatus.

At the central station an ordinary hornless phonograph is placed upon a table along with the wireless telephone apparatus. The shutters at the front of the phonograph are removed and within the "horn" section one or more ordinary microphones are placed, these being connected by wire with a pair of binding posts on the telephone. A cable connects the telephone with the aerial upon the roof. When the phonograph is started the music is caught by the microphones and carried by wire to the wireless telephone instrument, which, after serving as an amplifier continues it on its way to the aerial. After leaving the aerial the sound is caught by the various radio receiving station apparatus, which latter are connected by wire with ordinary telephone receivers, these being equipped with small megaphones, the work of which is to assist in increasing the volume of sound. An important feature about this wireless music transmission is that so far as can be ascertained the music heard at the receiving stations is equally as loud as is that furnished by the phonograph. The central operator has absolute control over the volume of sound furnished by this device, this depending entirely upon the amount of electrical energy employed.

WHAT MAKES THE MATCHES GO AROUND?

A very clever electrical window attraction is shown in the accompanying illustration and is known as the "Mysterious Match Box." The device is much in demand by all merchants, both large and small, having show window space as it can be operated on batteries and does not necessarily require electric light current.

It has been widely used by retail drug stores and has proven very satisfactory as a business "booster." In operation the matches lie down on the upper plate and at certain moments rise and start to rotate. Directly, however, they collapse again and the action repeats itself periodically, much to the amusement of the wondering public. Any one of a thousand different objects can be made to operate on the piece of glass which forms the top of the cabinet, thereby giving the public something different to think about as frequently as the merchant may desire. A cigar placed flat on top of the glass will rise, whirl in a circle for an instant and return to its original position, repeating this movement continuously.



The Matches Rise, Rotate Then Collapse, Repeatedly.

Possibly the greatest features of all the moving attractions which may be worked with this invention is a display card carrying advertising matter on both sides. When placed flat upon the glass top, it will rise, turn around and then fall back upon the glass again. This operation is kept up continuously in the same way that the matches behaved.

In Zurich, Switzerland, street cars are run by liquid air.

A NOVEL ELECTRIC RUBBING AND POLISHING MACHINE.

In the accompanying illustration is perceived one of the latest electrically operated grinding, sanding, rubbing and polishing machines adaptable for manufacturing requirements where furniture, stone work and the like are to be dressed, surfaced and polished. The machine operates at very high efficiency and thus costs but a very small amount per hour for its operation. It may be connected up with any lamp socket. The polishing element of the device is driven by a small but sturdy motor, especially designed for the work. The whole device measures 16 inches long, 5½ inches wide and 12 inches high, and weighs 25 pounds. The two felt pads mounted on the face or underside of the machine, each of which measures 5½ by 4½ inches, shift about in an oscillatory fashion over 400 times per minute. A switch is mounted conveniently on the base of the device to control the motor circuit. Black fiber handles are provided, which eliminate any possibility of the operator receiving a shock.

Unique Electric Polishing Machine.

MOTORCYCLE HELPS LIGHT A TOWN.

When the town of St. Charles, Mo., was left in darkness a short time ago by the breaking of the high-powered transmission cable from the great Keokuk dam on the Mississippi, a motorcycle helped to save the situation in a unique manner and keep the town lighted. Before the town secured current from the Keokuk dam it was illuminated by a steam power plant which drove a 150-kilowatt generator. When the engineers came to hook up the abandoned steam plant they found it possible to get up steam and run the big generator, but discovered at the same time that a very important auxiliary, the little exciter generator, which is run in conjunction with the big machine to excite the fields of same, was out of commission. The sub-station of the Keokuk plant, however, is of the same general type, except that the generators there are driven by motors which take current from the transmission line. The exciter at the sub-station was available, and if power could be obtained to run it the current could be transmitted to the old steam plant and by a combination of the two units the town would be lighted. About that time it occurred to E. F. Wayee, electrician and trouble man employed by the Electric Co. of Missouri, that there was power enough in the engine of his Indian motorcycle if it could be harnessed.

A Motorcycle Used to Drive the Exciter for the Large Dynamos Here Shown Prevented St. Charles, Mo., from Being in Darkness.

No sooner said than done. He set his motorcycle on the stand, took off the tire, slipped on a belt from the rear wheel to the pulley of the little exciter and started his gasolene engine. For an hour and a half he pulled the exciter and furnished the city with light for that period of time, while the wires to the Keokuk dam were repaired. The motor was run on wide-open throttle the entire length of time emergency service was required.

PLANS WIRELESS SERVICE IN MISSISSIPPI.

Frederick de Lamorton who is a wireless operator from the Pacific Coast, whose base of operation has extended as far north as Alaska, and as far south as the Panama Canal, recently spent a few days at his father's home in Laine, Miss., prospective of establishing a wireless station at the port of Pascagoula or Moss Point, for the benefit of the lumber and general shipping interests of that port and the Mississippi Gulf Coast.

The station which is being planned for establishment is to have a radius of 2,500 to 3,000 miles.

ELECTRIC ENGINES PROVE STRONGER THAN STEAM TYPE.

On the Pacific slope of the Rocky Mountains, in sight of Butte, Mont., electricity recently won a decisive victory over steam power. The test was a haul of freight trains up the Continental divide and is said to have been the first practical pulling contest ever arranged to determine the advantage of one power over the other.

One of the trains in the competition weighed 2,200 tons and was drawn by three steam locomotives. The other weighed 3,000 tons and was pulled by a two-unit electric engine. At the time set an electric engine started up the 2 per cent grade, rounded the big curve and sped on at a uniform pace and without apparent effort. A few minutes later the three locomotives came chugging and laboring up the same hill hauling their lighter load.

The contest determined the use of electric engines over the 440 miles of main line from Avery, Idaho, to Harlowton 113 miles of which have already been electrified.

HOW LONG DOES RADIUM LAST?

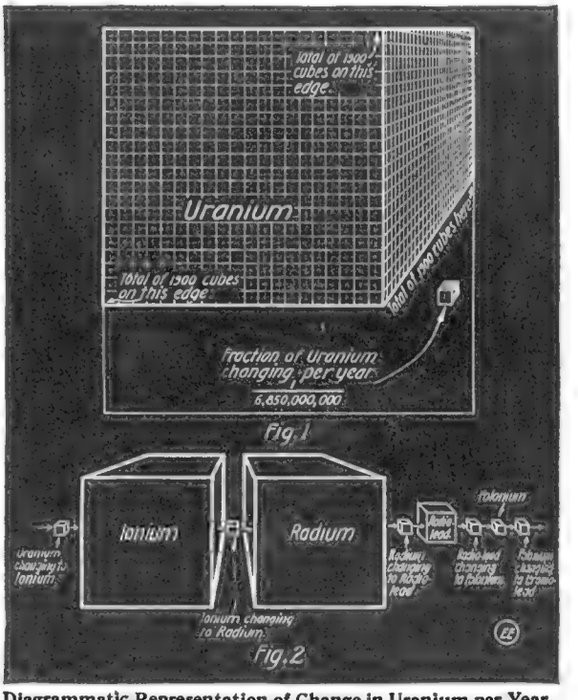
In determining the life of radium, or, in other words, the total time period of deterioration of this remarkable element, it would be quite a simple matter to arrive at the conclusion if radium were formed directly from uranium, thus making it easily possible to separate the radium from a quantity of mineral containing a known amount of radium. The uranium could then be purified so as to be free from all trace of the radium and to allow it to remain until a measurable amount of radium had been produced within it, then to compare the radium so formed from the uranium with the radium present initially in the mineral.

B. B. Boltwood mentions in *Science* that this was attempted, but it was found that radium was produced too slowly to be determined with y accuracy and was far less than was to be expected from theoretical deduction. At any rate, the writer states that this obstacle was overcome in 1907, when he was able to separate from uranium minerals a previously unidentified radio-element which was intermediate between uranium and radium in the series of atomic transformations, and which by its own disintegration produced radium in readily measurable quantities. The name "Ionium" was given to this element. Thus it became possible to separate the ionium element from a mineral containing a known amount of radium and to determine the rate of growth of radium in this ionium. This is a measure of the rate of production of radium in the mineral and therefore a measure of the rate of disintegration of the radium.

The two diagrams (Figs. 1 and 2) will perhaps be useful in making the general conditions and method of procedure more easily understood to those without a technical knowledge of the subject. In the first (Fig. 1) the amount of uranium changing per year relative to the total amount present is shown by two cubes whose volumes are proportional to the number of atoms involved in the transformation. In the second diagram (Fig. 2) the first cube on the left is supposed to be of the same size as the smaller cube in the first figure. Since the constant change of ionium is as yet undetermined, it has been assumed for convenience to be approximately the same as that of radium, and the amount of ionium in the mineral is therefore indicated as of the same order as the amount of radium. With this limitation, and omitting the slight complications involved by the existence of branch products, like actinium, and products of a rapid rate of change, like the emanation and radium-A, the diagrams represent the general conditions and changes to be found in an old uranium mineral.

The chief relation of interest shown by the diagram is that since the radium changing to radio-lead cannot be determined experimentally with sufficient exactness, it is equally satisfactory and very much simpler to determine the ionium changing to radium and compare its quantity with the total amount of radium in the mineral. As a matter of fact, the actual amounts of radium involved in these two quantities need not be known, it is only their relative values which are required, since the value of the disintegration constant is determined by the ratio of one of these to the other. In this respect the method is independent of any standard of purity of radium preparations, an advantage which is not possessed by other methods which have been used for attacking the problem. Thus, for example, the estimate of the half-value period of radium made by Rutherford and Geiger as a result of their experiments in 1908 had to be altered from 1,760 years to 1,699 years when, in 1912, the present international radium standard was adopted.

In some thorough and interesting research work carried on by Miss Gleditsch, and cited by Mr. Boltwood, there were determined some valuable figures on the probable disintegration period of radium. In four results of experiments carefully conducted the following half-value periods of radium were found, viz., 1,836 years, 1,780 years, 1,640 years, 1,670 years.



Diagrammatic Representation of Change in Uranium per Year. Also Successive Disintegration of Uranium.

Dropping Aerial Bombs Thru a Cone of Light

A NOVEL bomb-dropping scheme is depicted in the painting reproduced on our front cover. This scheme is intended for use in conjunction with Battleplanes, the aerial bombs being dropped through a cone of light. This powerful illuminant is composed of a ring of high candlepower electric lights. Each lamp is supported in a separate reflector under the hood of the bomb-dropper as shown in the accompanying illustration. The various light beams from each lamp cross the other beams and in this manner a concentrated cone of light is produced as is evident. The lamps themselves may be the new incandescent arc units recently developed and perfected by the Ediswan Company of England. This unit has the appearance of a high candlepower tungsten bulb, but instead of heating a fine wire filament in the usual manner, an arc between tungsten or other high fusing alloys is made the source of light.

These incandescent arc lamp units can readily be constructed to yield as high as 3,000 C.P. If then, we should use, say, 20 such lamps (the effiency being 2 C.P. per watt of electrical energy), there would be required 30 K.W. or 40 H.P. with total resultant C.P. of 60,000. The present tendency in building Battleplanes is toward massive proportions, involving engines developing several hundred horsepower. Therefore the energy required for the bomb-dropper illuminant is not unreasonable, and besides it can be built in smaller sizes than here suggested. The energy necessary for operating the electro-magnets which release the bombs one after another (independently but consecutively) is slight and could be supplied by a small storage battery. A dynamo direct-connected to the main engines would probably be found best for the source of current for the high candlepower lamps. Furthermore, there might also be used a form of *cold light*, which, it has been said, a French scientist has quite recently invented.

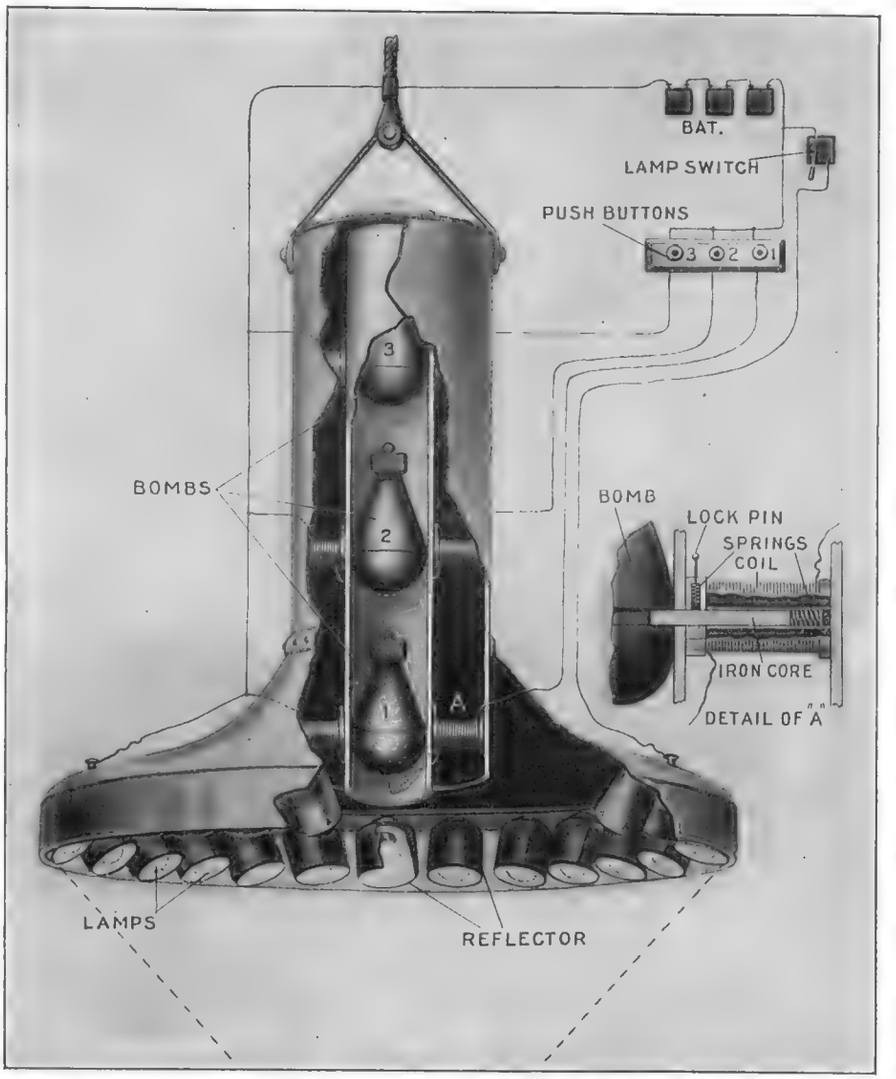
Reports state that the French war office experts are now experimenting with this new type of searchlight proposed by the French professor, Dussaud, which will throw a blinding beam to unheard of altitudes and betray the Zeppelins to the French batteries and aeroplanes.

Professor Dussaud's cold light is generated by utilizing nearly 100 per cent. of the electric current for illuminating instead of losing 70 or 90 per cent. of the power in generating useless heat, as in the ordinary electric lighting system at present.

Hopes are entertained that this system will produce a searchlight five times stronger than the old types, with over 100,000 candle power. These new lights will absolutely blind everything in their path it is said and will bore a luminous hole through the heaviest cloud strata.

At any rate there are a number of powerful electric lamps available for this purpose and by means of a switch on the aeroplane the illumination can be instantly cut off as desired. The bomb-dropper with its ring of lamps is suspended at the lower end of a flexible steel cable and the wires controlling the whole outfit follow this cable also. When necessary the suspension cable is wound up by a power-driven winch and the bomb-dropper can thus be raised right up into the 'plane through a suitable opening in the floor of the machine. It is proposed that the bombs be put up in magazine holders, each of which may contain eight to twelve bombs. It will then be a simple matter to reload the bomb-dropper by inserting one of these prepared magazines, just before the device is again lowered to the proper level.

Referring to the sectional view of the bomb-releasing mechanism, it will be observed that each bomb is retained normally in the vertical magazine tube by a pair of electro-magnets provided with sliding cores. The two cores engage, when projecting within the tube, an annular groove turned in the wall of the bomb. Each pair of magnet coils, corresponding, of course, to a certain bomb, is connected to its own individual push button on a control switchboard aboard the Battleplane. Hence by pressing buttons marked No. 1, No. 2, No. 3, etc., consecutively, the death-dealing missiles will be dispatched earthward with scientific precision and without, moreover, endangering the life of a bomb-dropping expert suspended in a basket at the end of the cable, a scheme said to be employed by the German Zeppelins.



Details of electrically controlled Bomb-Dropper depicted in action on the front cover. A set of electromagnets release each Aerial Bomb at the touch of a button at battleplane commander's side.

In reloading the bomb-dropper the magnetically operated retaining rods are released by simply pulling upward on the locking pins, which are spring actuated as the illustration clearly shows. When the magnet core is pulled inward by exciting, the winding with current from the 'plane above, the locking pin drops into a notch in the core. It cannot move outward again to obstruct the path of the remaining missiles, until the entire mechanism is hauled aboard again. The locking pins can then be manually released, when the bombs are in position, and the springs behind each core will force them outward for the purpose set forth.

This scheme has several distinctive features. For one thing, the dropping of the bomb through a circle of light is bound to increase the accuracy of the marksman, as this arrangement corresponds to a flash-light-pistol which has been proven to possess a deadly accurate fire. Once the target lies in the center of the circle of light, a missed shot becomes a rarity indeed. Identically the same efficiency holds here, modified naturally to some extent, by the movement of the Battleplane in its flight, which makes the work of the aerial gunner considerably more difficult. Should the enemy start shelling the bomb-dropper illuminant, the lamps can be instantly extinguished. Then the armored Battleplane can rise quickly and speed away in safety before the hostile searchlight beams manage to locate it.

By the construction of a dam below Niagara Falls, it is planned to raise the water 90 feet, thus tripling the power now being derived from this great source. This can be done without diverting any water from the crest, which would be likely to mar its beauty.

NEW EDGEWISE ILLUMINATED ELECTRIC SIGN.

What is known as the Polaralite electric sign is shown in the illustration produced herewith. Unique indeed is the method by which the passer-by is attracted by this display. We are all more or less familiar with electric signs, to be sure, where the

The Two Bottles as Well as the Center Plate Light Up in This Sign.

The Two Glass Signs Here Portrayed Are Illuminated by Reflecting Light Through Them Edgewise.

illumination is concentrated either at one or several points. These signs, which, by the way, are works of art, have no highly intrinsic point of illumination perceptible. Instead, the whole sign, which is made of fairly thick glass, is illuminated by a special long tubular incandescent bulb contained in the base of the structure. The light is allowed to filter through the lower edge of the upright glass containing the advertisement. In this way, by having the light rays shoot upward through the glass, a very beautiful and engaging effect is produced. In the sign here illustrated, containing the two bottles at either end, the bottles are illuminated as the sign lights up. In some signs the illumination flashes on or off, but in other cases the light is left on steadily. In either event the effect is beautiful and out of the ordinary.

STOCKHOLM WIRELESS CAN REACH U. S. NOW.

Wireless messages can now be sent from Stockholm to the United States by way of Nauen, Germany, to Sayville, it was announced recently. The messages must be in English and not longer than 25 words, and are sent at the sender's risk.

A FARMER'S AUTOMATIC TELEPHONE.

By Frank C. Perkins.

The accompanying illustration shows a farmer's automatic telephone which is utilized at Aberdeen, S. D., by the Farmers' Automatic Telephone Co. and which, it is claimed, makes possible a simple, practical and economical selective ringing, anti-"rubbering" lockout service for party lines.

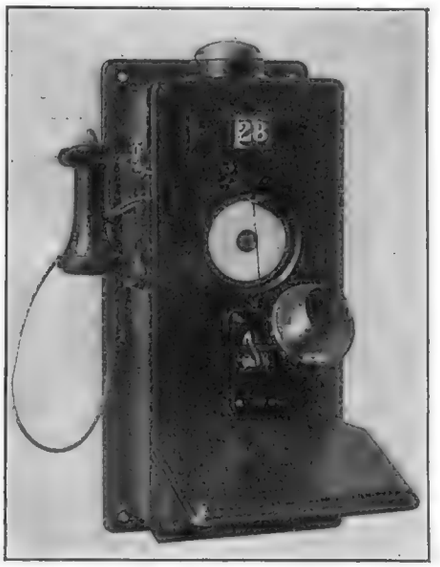
It is pointed out that this mechanism is installed in an ordinary telephone cabinet in place of the magneto generator and consists of a "selector" with numbered dial and an "impulse" mechanism. Twenty-five of these telephones can be on the line and each one can selectively call and be called by any other.

The method of operation is unique. When the line is not in use all the dials stand at zero and receiver hooks are all locked down. When a subscriber desires to call another he first connects his instrument to the line. This is done by inserting the pin in the pin-hole opposite his own number and then bringing it around to the top. When the dial stops moving his bell rings; he now removes the receiver and the hook goes up, making the connection with the line. He then takes the pin and inserts it in the pin-hole opposite the number he wishes to call and brings it to the top. When the dials stop with the selected number at the top the bell of the instrument called rings and its receiver hook unlocks.

It will be seen that the two people may then carry on a conversation without fear of anyone "listening in." If, however, a third party should desire to come in while the line is in use he can do so by bringing his number to the top, ringing his bell and unlocking his receiver hook; but when doing this the two persons already on the line will notice the movement of their dials, and when it stops will know who has come in.

This is preferable to an absolute lockout system which prevents a third party coming in at all, or at the will of a central operator. A central operator cannot always exercise good judgment in handling a line of telephone users of various whims and dispositions. The farmers' automatic set relieves the central operator of this disagreeable duty. Any system which allows a central or the subscribers to absolutely lock out a third party must meet with many serious objections.

It is held that this instrument particularly meets the wants and demands of the farmers for better telephone service.

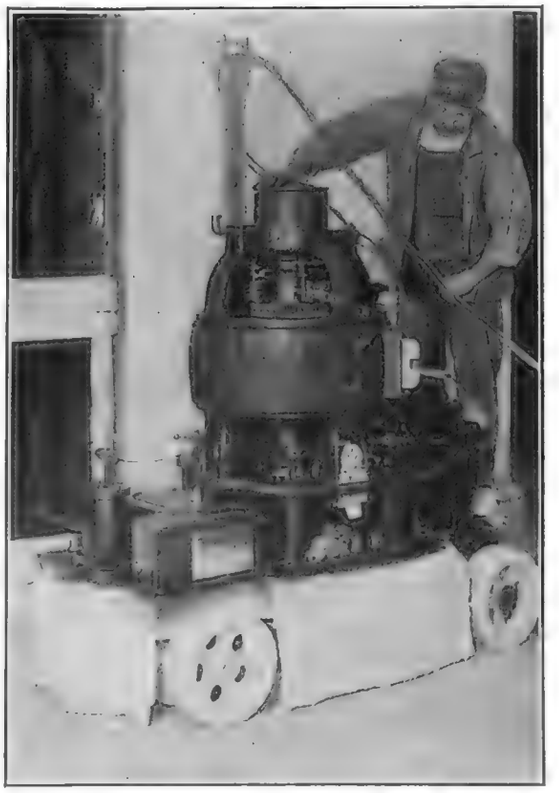


A Selective Calling Automatic Telephone for Farmers' Lines.

The cost of instruments is but little more than that of other telephones, and the cost of maintenance of the line is increased only by the expense of a line battery, or similar means for giving current to the line. The cost of line upkeep is equal to that of a telegraph line of the same length under similar conditions.

POLISHING TILE FLOORS BY MOTOR.

Ordinarily tile floors are invariably put down by artisans skilled in this work, and the paper on which the small pieces of tile are pasted is simply washed off. However, when it comes to smoothing and polishing several thousand square feet of such floor surface, it is a man's size job, and the trusty electric motor has been brought into play once more for this particular work. The illustration herewith produced through the courtesy of the New York Edison Co. shows a powerful motor-driven tile floor polishing machine being operated in the new Municipal building in New York City.



A Powerful Motor-Driven Polisher for Tile Floors.

The motor on these machines develops 13 h.p. The complete outfit weighs 1½ tons. The motor operates the brush secured to the lower end of the motor shaft at 220 r.p.m. What one of these machines really is capable of accomplishing in a working day is astonishing. That it should work ten times faster than hand operation is not surprising, but, however, what is a more telling fact is that one of these monster polishers does well over 500 square feet per day. For border work a machine of 1-6 h.p. is made use of. Thanks to electrical operation, the contractor with an average force of 75 men was able to accomplish his share of the city's work in a little less than nine months.

ILLINOIS MAY HAVE STATE WIRELESS STATION.

Governor Dunne is considering a plan, it became known recently, to have a powerful wireless apparatus installed at the State House at Springfield, Ill., as a part of the military equipment of the State.

As suggested to the Governor, the plan calls for antennæ reaching from the dome of the State House, 360 feet high, to the roof of the State power plant smokestack, which when completed will be 200 feet high.

Tesla's Early Work With Radio Controlled Vessels

ALTHOUGH present day inventors are prone to shout loudly about their marvelous schemes for controlling torpedoes, boats or other mobile bodies by wireless, it is interesting at this time to take note of the fact that a very complete patent on an ingenious radio control system for torpedoes, etc., was issued to Nikola Tesla in the year 1898, or over eighteen years ago. At that time the science of radio telegraphy was barely on the threshold of possibilities and how far ahead of his time this great scientist is will be the more evident after perusing the following paragraphs:

The illustrations herewith are photographs of the early models constructed by Dr. Tesla and which were actually tried out with entire success. The diagrammatic illustrations will help to explain the working parts of the telemechanical models as outlined in his patent. Fig. 1 shows a model vessel corresponding to that shown in the sectional views, while Fig. 2 represents a model constructed at an earlier date.

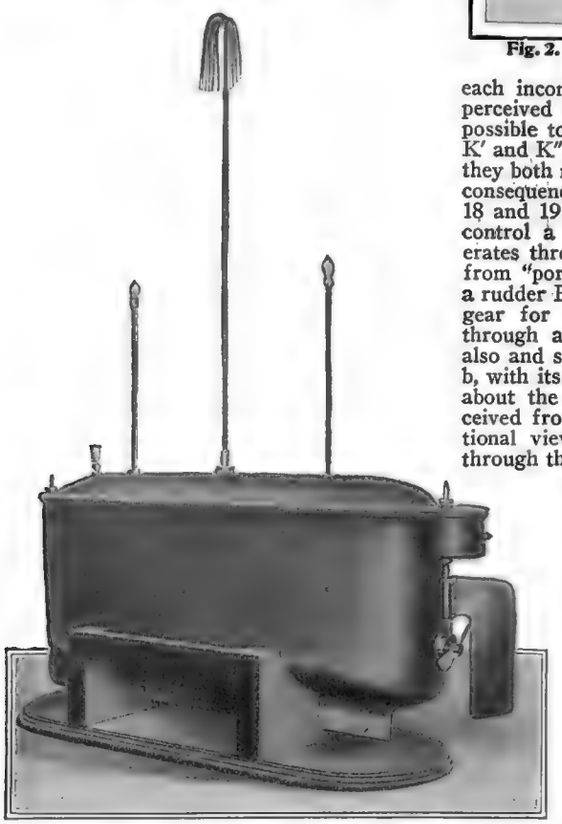


Fig. 1. Tesla's Radio-Controlled Boat Model, Which Was Built Over Eighteen Years Ago.

Referring to diagrams 3, 4, 5 and 6 respectively, we have in general a radio wave sensitive device resembling the well-known coherer at c. This is supported in a special movable holder on the de-cohering or resetting mechanism a and f. The radio receptor circuit connected with the coherer c leads to a grounded connection at B′ (see Fig. 4), and an elevated aerial or antenna system E′. A radio transmitting station on shore utilizes a spark gap S, with an elevated aerial and ground circuit hooked-up in the usual manner. A source of high potential current at T is provided to charge the spark gap, thus sending out periodically radio waves of a given frequency. A control switch is mounted on the end of the cabinet at T, and this passes over four points T, T′, U, U′. This part of the radio control arrangement will be referred to later.

When an incoming wave passes through the coherer circuit, it causes the relay a and the de-cohering device f to function, and simultaneously a commutator device j′ and j″ to rotate a quarter of a revolution for each incoming wave impulse. As will be perceived by referring to Fig. 6, it is thus possible to cause two major control relays K′ and K″, to be closed alternately or again they both may be left open-circuited, and in consequence their local or armature circuits 18 and 19 will be left open. These relays control a reversible motor, F, which operates through a worm gear drive to turn from "port" to "starboard," or vice versa, a rudder F′. Referring to Fig. 3, the worm gear for motor F moves the rudder F′ through a gear H″, as becomes evident; also and simultaneously the movable sleeve b, with its attached insulated disk L′ moves about the fixed vertical rod H. As perceived from the various diagrams and sectional views, this disk L′ when rotated through the agency of the steering motor F, will cause a series of metal segments 9, 10, 11, etc., to pass under a set of spring metal brushes 1, 2, 3, 4, etc., which are secured to the fixed insulating member L. The movement of this connector disk controls the circuit of the propelling motor D, connected through a shaft in the usual manner to a screw-propeller C (see Fig. 3). The energy for operating the motor, etc., is obtainable from the storage or other batteries E, carried in the moving vessel.

Tesla in his early patent mentions specifically that the transmitting and receiving radio circuits should be tuned to corresponding wave lengths or at least a harmonic of same. He also mentions that it is possible (although not considered in the present discussion) to control as many as fifty or a hundred circuits, each tuned to a distinct and different transmitting wave length. Of course a different transmitting wave length would be sent out for each control step desired to be put in action at the receiving device in this case.

The coherer of this early vintage is very interesting and comprises a metal cylinder c (detail in Fig. 5), with insulating heads c′, through which passes a central metallic rod c″. A small quantity of grains d, of conducting material (such as an oxidized metal) is placed in the cylinder. A metallic strip d′, secured to an insulated post d″, bears against the side of the metal cylinder c, forming one part of the circuit. The central rod c″ is connected to the frame of the instrument and so to the other part of the circuit, through the forked metal arm e, the ends of which are fastened with two nuts to the projecting ends of the rod, by which means the cylinder c is supported.

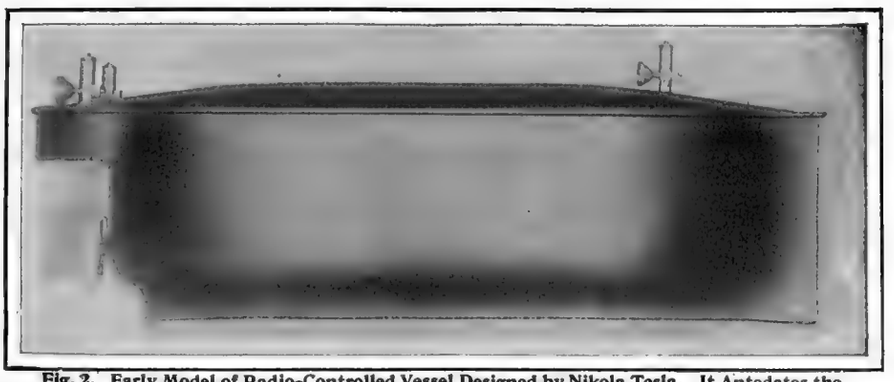


Fig. 2. Early Model of Radio-Controlled Vessel Designed by Nikola Tesla. It Antedates the Model Shown at Fig. 1.

In order to interrupt the flow of battery current, which is started through the action of the sensitive coherer, special means are provided, which are as follows: The armature e′ of the relay magnets a, when attracted by the latter, closes a circuit containing a battery b′ and magnet f. The armature-lever f′ of this magnet is fixed to a rocker-shaft f″, to which is secured an anchor-escapement g. This controls the movements of a spindle g′, driven by a clock-train K. The spindle g′ has fixed to it a disk g″ provided with four pins b″; hence for each oscillation of the escapement g, the spindle g′ is turned through *one-quarter* of a revolution. One of the spindles in the clock-train, as h, is geared so as to make *one-half* of a revolution for each quarter-revolution of spindle g′. The end of the former spindle extends through the side of the frame and carries an eccentric cylinder h′, which passes through a slot in a lever h″, pivoted to the side of

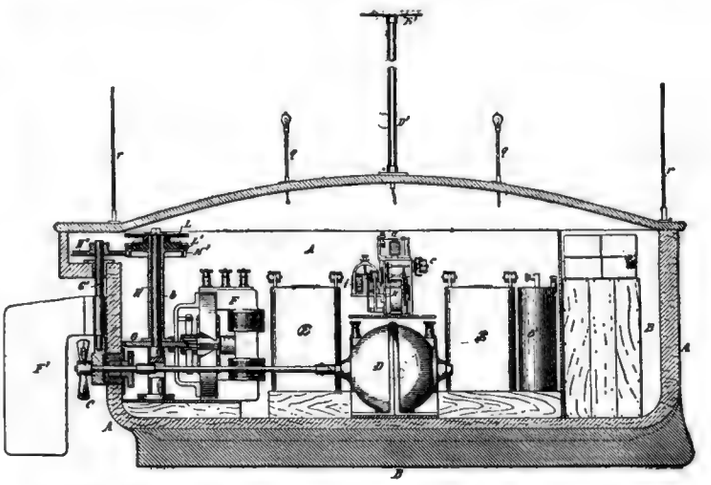


Fig. 3. Sectional View of Telemechanical Vessel Illustrated at Fig. 1.

the frame. The forked arm e, which supports the cylinder c, is pivoted to the end of eccentric h', and the eccentric and said arm are connected by a spiral spring i. Two pins i'i' extend out from the lever h", and one of these is always in the path of a projection on arm e. They operate to prevent the turning of cylinder c with the spindle h and the eccentric.

It will be evident that a half-revolution of the spindle h will wind up the spring i and at the same time raise or lower the lever h", and these parts are so arranged that just before the half-revolution of the spindle is completed the pin i', in engagement with projection or stop-pin p, is withdrawn from its path, and the cylinder c, obeying the force of the pring i, *is suddenly turned end for end*, its motion being checked by the other pin i'. The adjustment relatively to armature f' of magnet f is furthermore so made that the pin i' is withdrawn at the moment when the armature has nearly reached its extreme position in its approach toward the magnet—that is, when the lever l, which carries the armature f', almost touches the lower one of the two stops s s (Fig. 5), which limits its motion in both directions.

The normal position of the cylinder c is vertical, and when turned in the manner described, the grains in it are simply shifted from one end to the other; but inasmuch as they always fall through the *same space* and are subjected to the *same agitation* they are caused, after each operation of the relay, to offer precisely the same resistance to the flow of the battery current, until another radio impulse from afar reaches the receiving-circuit.

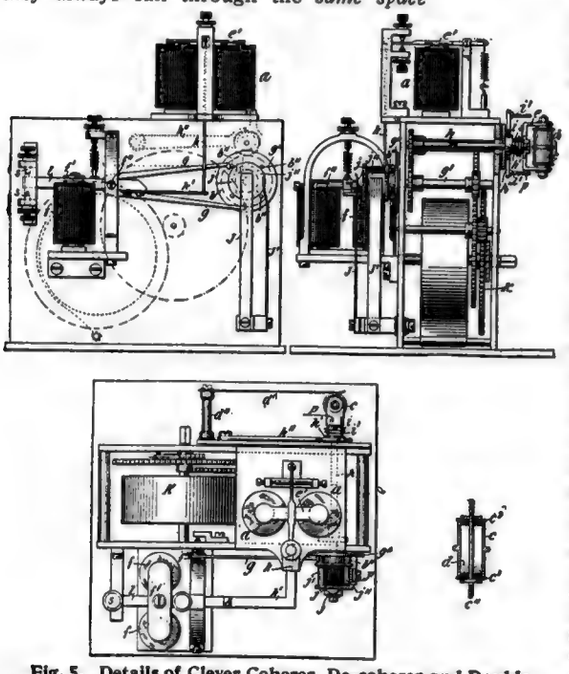


Fig. 5. Details of Clever Coherer, De-coherer and Double Relay Scheme.

The relay-magnet a should be of such character as to respond to a very weak current and yet be positive in its action. To insure the retraction of its armature e' after the current has been established through the magnet f and interrupted by the inversion of the sensitive device c, a light rod k is supported in guides on the frame, in position to be lifted by an extension k' of the armature-lever l, and to raise slightly the armature e'. As a feeble current may normally flow through the sensitive device and the relay-magnet a, which would be sufficient to hold though not draw the armature down, it is well to observe this precaution.

The operation of the relay-magnet a, and the consequent operation of the electro-magnet f, as above described, are utilized to control the operation of the propelling-engine and the steering apparatus in the following manner: On the spindle g', which carries the escapement-disk g" (Figs. 4 and 6), is a cylinder j of insulating material, with a conducting plate or head at each end. From these two heads, respectively, contact plates or segments, j' j" extend on diametrically opposite sides of the cylinder. The plate j" is in electrical connection with the frame of the instrument through the head from which it extends, while insulated strips J J' bear upon the free end or head of the cylinder and the periphery of the same, respectively. Three terminals are thus provided; one always in connection with plate j', the other always in connection with the plate j", and the third adapted to rest on the strips j' and j" in succession, or upon the immediate insulating-spaces, according to which of the four distinct positions the commutator is brought to by the clock-train and the anchor-escapement.

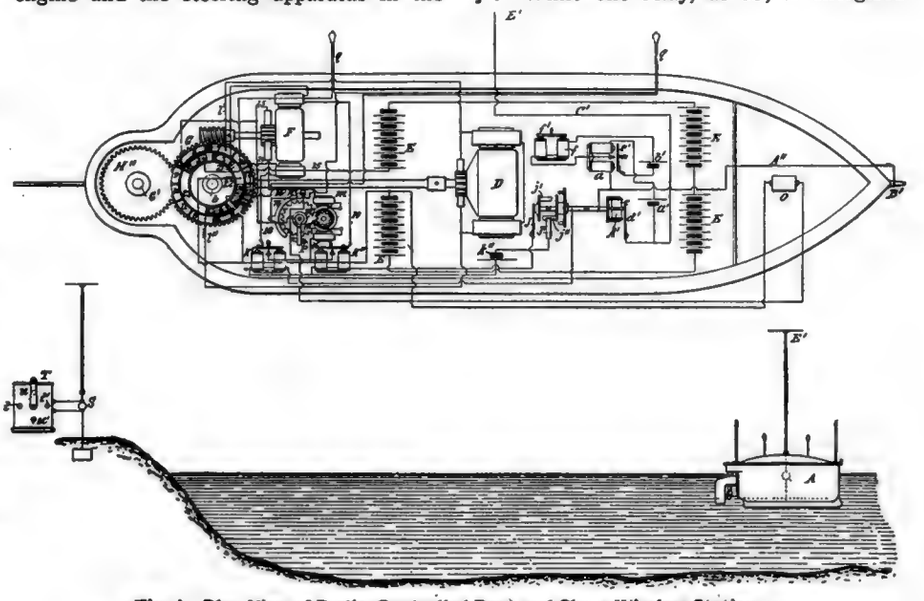


Fig. 4. Plan View of Radio-Controlled Boat and Shore Wireless Station.

At K' and K" (Figs. 4 and 6) are two relay-magnets conveniently placed in the rear of the propelling-engine. One terminal of a battery k" is connected to one end of each of the relay-coils, the opposite terminal to the brush J', and the opposite ends of the relay-coils to the brush J and to the frame of the instrument, respectively. As a consequence of this arrangement either the relay K' or K" will be energized, as the brush J' bears upon the plate j' or j", respectively; or both relays will be inactive while the brush J' bears upon an insulating-space between the plates j' and j". While one relay, as K', is energized its armature closes a circuit through the motor F, which is rotated in a direction to *throw the rudder to port*. On the other hand, when relay K" is active another circuit through the motor F is closed, which reverses its direction of rotation and shifts the *rudder to starboard*.

A small auxiliary motor, m, may be employed to control signaling lights erected on masts above the deck of the vessel, so that the operator on shore can tell in the dark just how and in what direction the telemechanical vessel is progressing through the water. This signaling motor arrangement is connected in series with the armature of the steering motor F, so that whenever either one of the circuits of the latter is closed through relay K' or K", the motor m is likewise rotated, but in any case in the *same direction*. The signal lamps may be colored to facilitate matters. By this mechanism it is also possible, by sending out a predetermined series of electric wave impulses, to cause its spring repelled switch arm m" to come in contact finally with switch point n', thus closing a circuit through a special device o, which might, for instance, be the detonating cap of an explosive chamber in the case of a radio-controlled torpedo.

With regard to the method of handling the entire outfit, we may now have reference to Figs. 4 and 6. Here S designates

(*Continued on page 136*)

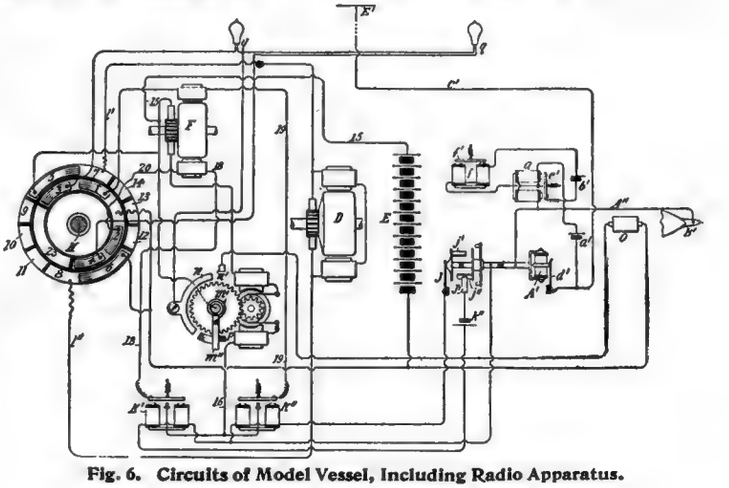


Fig. 6. Circuits of Model Vessel, Including Radio Apparatus.

When Electricity Entered the Home

By Thomas Reed.

PICKING up a magazine, to while the time away as I listen through the receiver for flurries in the wireless world, my eye lights on a double-page advertisement headed "Electricity in the Home," and showing pictures of a hundred fascinating rinktums through which everything in the home can be done for you by the busy and accommodating little ions, except washing the dog and getting Johnny in at supper-time. And as I pore over them, I look back to the old, old days when the only application of Electricity in the Home was the Electric Belt.

The electric belt held the place of honor in the advertising-columns of every paper, from the *Farm and Poultry Oracle* to *Godey's Lady's Book*. Sometimes it was pictured in its habitat around a man's waist (never a lady's; it wasn't considered well-bred then for a lady to appear in the public prints clad only in—er—under-necessaries of any sort); but most often the belt was suspended in air so you could look at the back of it and see the ring of high-tension sparks exuding from each of the copper and zinc discs hidden somewhere inside. It was only in the advertisement that it was so energetic; when you got it home its voltage had dropped perceptibly—dropped so far, in fact, that it could be handled with practically no danger of electrocution.

How slowly new inventions make their way! Volta discovered that zinc-copper-saline-solution thing way back in 1800; and you'd expect him to get a little simple thing like a belt on the market in quite a lot less than seventy years, now wouldn't you? Why, the G. E. Co. would have had one in the 1801 spring catalogue at the latest. But it wasn't till after 1870 that the belt idea really struck in; and then, of course, as usual, the patent had expired, and Volta, too. Regular inventor's luck!

It had to wait for the development of advertising "with a punch"; and the punch in this case was the catch-phrase "Electricity is Life." That was the stuff; what more could you claim for a curative agent and still be conservative? People were getting tired, anyway, of the old-fashioned remedies, like pulverized toads, and then, too, they cost so much; you had to keep buying them and buying them. But this belt was a thing that went right on curing after the first outlay with no expense whatever. Practically one to a family was enough, or even one to a neighborhood, provided the neighborhood was small and conscientious about the weekly bath. It was a great "talking point" in the hard times.

My father used to buy these belts for their curative properties. There was nothing really the matter with father, except that elusive disease known as "what-ails-you," so the belts did him a world of good.

The minute you put one on, he said, you could feel the warmth generated by the powerful currents of electricity, as they forced their way through the high resistance of the "organs," on the well-known principle of C-equals-E-over-R. Also, there was a distinct tickling sensation caused by the electricity hunting around over the skin to find the pores. (The belt had four thicknesses of red flannel; but that had practically no influence on its electrical output.)

Father always had two belts on hand—one for a "spare," in case of a breakdown. I cut the "spare" open once to get a diagram of the hook-up. I was disappointed there, because the only hook-up I could find was the strap-and-buckle in the front. The metal discs were sewed to the flannel an inch or so apart (to avoid short-circuiting, I suppose) and that was about all.

". . . .In sewing father's electric belt up again, I accidentally left a needle in it. Perhaps you think he was annoyed? On the contrary . . . . he said it was an unusually powerful belt; best one he ever had."

In sewing the belt up again, I accidentally left a needle in it. When it went into commission, the needle and father met, and the rendezvous was right over his liver. Perhaps you think he was annoyed? On the contrary, he was immensely pleased. He said it was an unusually powerful belt, best one he ever had. He reckoned that an especially active disc had got mingled with the others. It cured him completely of his liver-trouble and by rotating the belt a little every day, he finally had a completely-cured ring all around him. It did so well that he had a small belt built to treat him for rheumatism in his knee, but that one didn't do him any good. Its wave-length, or decrement, or something, wasn't right; anyhow, it never had the power the needle-belt had.

Electrical apparatus has changed a lot since father's day. Now you can laugh all you want to, but if he could come back I don't believe he would care for the modern rinktums in this advertisement—things that buzz, or boil, or kick when you hitch them to a socket. They can only do one trick per rinktum, and at the end of the month there's a kilowatt-bill staring you in the face. Not like his good old belt, full of discs and mystery and all kinds of powerful "properties" that worked while you slept and didn't dole their benefits out by *meter*. The world has grown better, of course, but prosy—awful prosy.

"Imagination had some play
In the days of old."

JOVIANS AND SOCIETY FOR ELECTRICAL DEVELOPMENT CO-OPERATE.

To effect even closer co-operation between the Jovian Order and the Society for Electrical Development, reigning Jupiter—Thomas A. Wynne, has appointed James M. Wakeman, General Manager; Harry W. Alexander, Director of Publicity, and George W. Hill, of the Field Co-operation staff, as Statesmen-at-Large in the Jovian Order.

The Jovian Order, with its nearly 20,000 members, has substantially the same object as The Society for Electrical Development, but the functions are different. The recent appointment will effect better co-operation which will consistently complement the work of both organizations, such as the founding and fostering of local Jovian Leagues, and the harmonizing of relations between local electrical interests.

The Jovian Order is an effective generator of the personal side of better business conditions in the industry, while the Society will represent, as it does now, more largely the definite business co-operation expressed in a corporate form. The Jovian Order accepts only personal membership while the Society membership is made up exclusively of firms or businesses.

During the "America's Electrical Week" campaign this fall, it is expected that the Jovians will exert great force in the handling of local sales committee work and celebrations. The Society will, however, conduct the national campaign as it did Electrical Prosperity Week.

Both the Society and the Jovian Order are growing in membership and the new plans for even more effective co-operation will undoubtedly be great boosts for both organizations.

These societies have done much valuable work in the extension of electric lighting and power service. Both the central stations and the customers have been benefited by their efforts.

The Wireless Wiz Plays War Lord

By Thomas Benson

PERHAPS others may have noticed that an expression will linger in the subconscious mind and any series of sounds will act as a sort of music set to the words. The Wizard's remark to the effect that those who laugh last are not always Englishmen was no exception to this rule.

" . . . . . 'Look!' one of the boys gasped, 'there is one of the raiders now.' We rushed to the windows and there, silhouetted against the dark sky, was a massive airship."

The words kept turning over in my mind and every trolley car, even the water dropping from a faulty faucet kept time to the words. Under such conditions a surprise would not be surprising, or putting it the other way, I was expecting the unexpected and naturally he went thru my guard and had his laugh.

The ether had been filled for some time with war talk, the President's latest note, submarine outrages and what not. They had become more than common and no self-respecting amateur would copy the stuff.

Three of the fellows were listening in on my set one evening when we were suddenly electrified so to speak by an extremely loud station sending "Q.S.T." or general call to all stations.

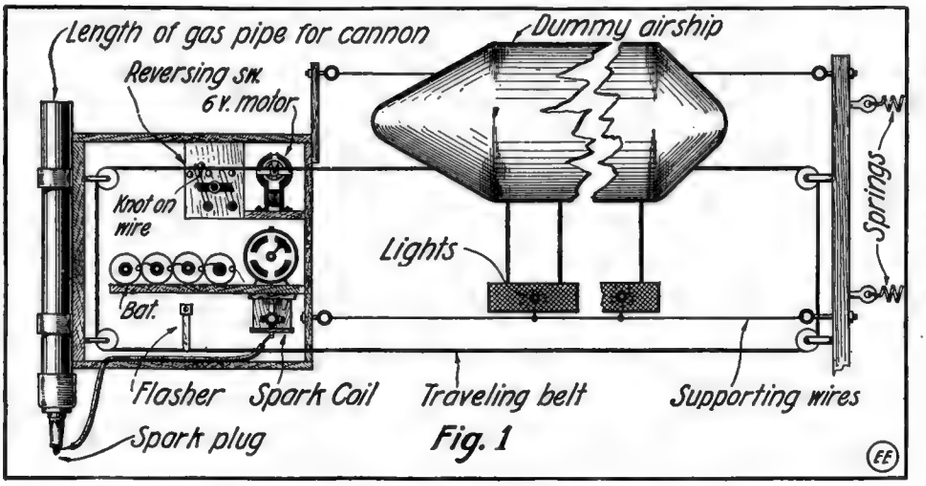
"Some hog on the ether," I muttered, trying to get his exact tune, but his wave was as broad as a housetop without a trace of a peak. "Coming in like a tidal wave, wonder what he has to shoot!" put in some one.

In silence we copied his stuff and looked at each other in amazement. No one wanted to show his "copy," thinking they would be laughed at for mistaking the signals, but an armistice was declared and comparing notes evolved this message:

Q.S.T.—Official reports have it that an air raid is planned on the United States by a foreign nation. The information was obtained by foreign representatives and it is believed that it is too late to prevent the attack. Citizens are advised to remain perfectly calm should their city be attacked and seek shelter at the first sign of danger. Further details are expected shortly.

(Signed) N. A. A.

"Arlington with that wave!" I spoke, half aloud, as the note had not the clear high pitch that usually identified that station. Still they may have tuned coarse and slowed up their gap so that every station would hear it without fail. The puzzle remained unsolved for we could not doubt that the country was in danger of attack despite the arguments of Pacifists to the contrary. That we might ultimately have to fight to hold the money obtained from the nations' cutting each other's throats was an accepted fact but such attacks would surely not be made until the main conflict was settled.



Schematic Arrangement of the Wiz's "Zeppelin" Surprise and How It Worked.

At the next club meeting we mentioned the matter and strange to say no others had copied the signals! The mystery was getting deeper. The penalty for false messages made a trick too dangerous. We were prepared to swear to message and the signature.

At first we were met with incredulity, but our very insistence demanded respect. Our story was told over and over and they had to believe, for even as there is honor among thieves so is there honor among the much maligned radio amateurs.

(*Continued on page 140*)

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

PROMPTLY as usual, on the second of 11 p.m., his Excellency "called." Perhaps it would be more correct if I had said hollered, instead of "called." For I have become mighty tired of wearing those Wireless head receivers all of the time, that make you look like a horse with blinkers over his head. A few days ago I installed my new *Audi-Amplifone*, and, in "Bug" language, it is "some peach." Why, if a half-dead wireless waif wave has strayed anywhere within a thousand miles of my station, I will hear it over my Audi-Amplifone as loud as a young brass band in a cemetery at 2 a.m.

I can now sit twenty-five feet away from the horn of the Audi-Amplifone and hear the slightest "rustling" in the ether perfectly plain. No matter how emaciated or how consumptive that wavelet is, I will hear it. It's great, you "Bugs," or my name isn't I. M. Alier!

(P.S.— If the Editor of this sheet wasn't such an insufferable crank, I would tell you right here how I constructed that Audi-Amplifone. Simplicity itself. First, take an old shoe-horn. Then borrow your father's safety razor. Next we need the wheel of a discarded wheelbarrow. Now, try and induce your local boiler factory to loan you a medium-size boiler, about 16 feet high and 9 feet in diameter, which we will need for the horn. After you have soldered the shoe-horn to one of the spokes of the wheelbarrow and riveted the safety razor blade to the closed end of the boiler, we are ready to mount the wheel with the shoe-horn . . . .

NOTE.—*We contracted with Mr. I. M. Alier to furnish us one Münchhausen story a month. So far he has broken his contract twice. We, therefore, cannot allow him, in fairness to other contributors, to run "How-to-Make-It" articles in this department; furthermore our space is limited.*—EDITOR.

(Didn't I tell you that Editor of yours is an unappreciative, soulless old "crab"? —I. M. ALIER.)

Martian Amusements

Well, anyway, Münchhausen was talking. His dear, croaking, sepulchral voice seemed to fill my wireless laboratory, and I shivered when I tried to realize that his voice had originated sixty million miles away from earth, and here I heard it as plain as if the dear old soul had been sitting five feet away from me instead of talking to me from the Planet Mars.

"My dear Alier," he began, "you are the only human being to whom I can rave about our Martian wonders, and I assure you it is a great relief to do so. It does not help much to voice my constant astonishments to Flitternix, for his brain is in a whirl much the same as mine all of the time. But it *is* a relief to pour out one's heart to someone who is not fortunate enough to have been transported into a civilization hundreds of thousands of years ahead of yours. But alas, I am raving again and you want to hear facts.

"Well, after our host had shown us a close view of the Earth and the planets by means of his extraordinary amplifying 'telescope,' he took us to an after-dinner 'show.' You see certain habits and customs are, after all, much the same on the two planets. Only the 'show' was a bit different than the ones we are accustomed to on earth!

"In one of the superb flyers of the Ruler we flew over the magnificently illuminated city and after a few minutes descended on an immense, slightly curved dome, forming the top of a building. This dome must have measured at least 2,000 feet across and it was constructed out of a single piece of transparent *Tos*. The dome itself must have been fully 400 feet above the ground. We walked towards the edge of the dome, where at one point a powerful yellow ray was playing at the arena below. Arriving at the source of the ray we peered down into the house, and we involuntarily caught our breaths. What a sight! There must have been at least 200,000 Martians below. And there was no noise, no talk, no sound of any kind! For the Martians do not talk aloud, all conversation being carried on by thought transference. It was uncanny to look at all these thousands of "speechless" Martians.

Before we could find time to think, a peculiar feeling of lightness had permeated us, we were wafted down the yellow beam, as if we had been so many dust particles floating in a sun ray.

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YOU are pretty well convinced that intelligent living beings exist on other worlds outside of our earth. It has been accepted for some time that intelligent living beings exist on Mars, that mysterious planet. If intelligent beings they are, what are their habits, how do they think, what are their sorrows, what their pleasures? Are certain human traits only to be found on earth, or has Nature's almighty wisdom seen to it that they prevail throughout the Universe?

Read this interesting instalment, brim full with new ideas; it opens up new possibilities of the capacity of the human mind.

"The house was entirely circular, built in the form of an ancient Roman amphitheatre, in other words like a circus. There were twenty distinct tiers, one above the other, with comfortable seats abounding. The arena seemed to be constructed entirely of transparent Tos as far as I could ascertain from the great height at which we were stationed at the time. While we were still marveling, our host had stepped between us and had walked us directly into the yellow ray. Before we could find time to think, a peculiar feeling of lightness had permeated us and we were wafted down the yellow beam, as if we had been so many dust particles floating in a sun ray. Down, down we went at a fair rate of speed, like angels floating in space, 500 or 600 feet, I don't know exactly how much, till we landed on a brilliantly illuminated platform. The second we touched it, the yellow ray was turned off and our original weight was restored to us. He then mounted a few steps and took seats in the luxuriously appointed "box" of the Ruler of the Planet Mars. The seats as well as the upholstery were white and soft, silk-like transparent Tos. The box itself was about forty feet above the arena, and was so placed that we could see nearly every one of the 200,000 Martians assembled in the House. No sooner had the Ruler sat down than every Martian saluted their chief, which they did by merely raising their left hand straight up, pointing it skyward. The hands were kept in this position for a few seconds. The Ruler returned the salute in a like manner for about five seconds. The salutation over, the show began instantly.

"The house was plunged into darkness, when suddenly an immense, dazzlingly illuminated ball appeared over the center of the arena, about twenty feet above the ground, where it hung suspended in space. In a few seconds another, very much smaller, brown ball appeared as if from nowhere. It was some fifty feet distant from the illuminated globe, and it was lighted upon its face by the latter. Another ball, slightly larger than the former, then appeared about twenty feet away from the second globe. Next, still another globe, a little larger than the preceding one, appeared, but this one had a tiny globe of its own accompanying it, but a foot or so distant from the parent one. Suddenly, we understood. *This was a mimic world.* The large illuminated ball represented the Sun. The first small ball was the planet Mercury, the second ball Venus, the third the Earth with its moon.

"In quick succession 'Mars,' with its two tiny moons; then the myriad of small asteroids appeared, followed by a much larger ball—Jupiter, which was larger than all the planets combined, not counting in its many moons. Next came Saturn, with its rings and its moons; then Uranus, and finally Neptune. No sooner had the last planet appeared than all of the planets began to rotate around their 'sun,' a most magnificent spectacle. After revolving for a few minutes, several of the planets slowed down, and finally all stood still.

"Our host explained to us (by thought transference) that these positions of the planets were absolutely accurate for the present time of the year, and that every Martian show opens with the mimic world exhibition, so that all Martians are kept informed of the relative positions of the planets and their respective distances from each other.

"What interested us most, however, was the fact that this mimic world was exactly proportioned, and that the distances between the mimic planets and their sun was also in proportion. By means of anti-gravitational means below the arena, as well as beneath the Tos dome, all exterior attractions and outside planetary gravitational effects were done away with, with the result that the globes hung suspended in space with nothing to make them fall down, exactly as our planetary system, which hangs freely suspended in space.

"Nor was the revolving of the mimic planets around their 'sun' accomplished by artificial means. It is true they were started revolving artificially, by invisible rays, directed from behind the scenes. But once started they kept on their elliptical courses, exactly as the real planets do, in strict accordance with the motion of all bodies suspended in free space. After the mimic planets had reached the desired positions (which their real brothers occupy in space), they were stopped by means of the same invisible rays which started them originally.

BE SURE TO READ THE JULY NUMBER

The July number of The Electrical Experimenter will be brimming over with good things. Several of the papers previously announced have had to be held over, due to lack of space, but the next issue will make up for the deficiency. Don't miss the July number; here are the reasons:

"Harnessing the Atmosphere's Nitrogen Electrically." By Samuel Cohen.

"The Gyroscope—Its Great Utility." By E. J. Christie, M.Sc.

"Water Wheel Drives For Private Lightin. Plants—How to Build Them." By H. Winfield Secor.

"Baron Münchhausen's New Scientific Adventures." By H. Gernsback.

New Tungsten—Molybdenum Alloy Substitute for Platinum.

"The Construction and Use of the Gold Leaf Electroscope." By E. H. Johnson.

"The Mimic Atom"—Part II. By Eric R. Lyon, A. B.

"The Electric Furnace." By Raymond Francis Yates.

Making Selenium Cells.

Popular Misconceptions of Magnetism (Including the Demagnetization of Watches).

Electric Shocks and How to Avoid Them.

"The next act was a beautifully rendered concert by some fifty young male Martians. It was a 'vocal' concert, no instruments being used. Nor did they open their mouths! Still they sang—by thought transference! This, of course, sounds violently impossible. Just the same, I assure you it was the best 'singing' I ever had the pleasure to 'hear.'

"I am equally certain that our lack of experience and training caused us to miss most of the beauty of the concert, for our mental capacity of receiving all of the impulses is of necessity much lower than that of a Martian.

"We probably heard the concert in the same manner as an intelligent monkey hears a Beethoven Symphony. He hears it perfectly—as perfectly as a human being—but he cannot understand its full meaning, because his mind cannot grasp it. Exactly so with us. Our minds were filled with the beautiful music, and while we caught much of the rhythm, the full meaning was necessarily lost upon us.

"The next act was almost entirely lost upon us. From what I could grasp from our host, it was a wonderful symphony of odors. It is well known to you that every smell or odor or scent causes a certain mind reflex or association; thus you are aware of the fact that certain perfumes or scents produce certain emotions upon our nerve centers. Certain scents will immediately conjecture a definite trend of thought upon you, all depending upon the intensity of your feelings. In the present day humans, this faculty of *correctly* associating thoughts with certain scents is as yet but little developed. With the Martian, it seems very highly developed; each scent, every moderation of scent has a certain well defined meaning.

"This is how the 'symphony of scents' was enacted. Perforated pipes were placed on top of the railing of all the tiers. This piping ran continuous through the entire house, while large supply mains led to a mixing and generating plant behind the scenes. The scents and perfumes were led in large mixing chambers, here to be blended scientifically by accomplished artists performing the 'symphony.' By means of pumps the scents were driven into the perforated pipes, but a few feet away from the audience, who thus simultaneously was enveloped into clouds of invisible scents and perfumes. The 'clouds' came at times in puffs, at times they were sustained, sometimes they were long drawn-out, changing from one scent into another. We could detect a certain rhythm throughout, and from the ecstatic expressions on the Martian's faces we understood how deep their feelings were during the performance, which lasted well over half an hour.

"Upon us the full meaning was, of course, lost, for we did not understand it all, but just the same our sensations were delightful in the extreme, and exceedingly pleasant. Just exactly what the feelings of the Martians were, and just what mental pictures or emotions the various scents produced upon their nerve centers, we have, of course, no means of knowing, but we knew that their systems responded very powerfully to the performance.

"The next act was a dazzling acrobatic performance of several Martians, going through marvelous evolutions in free space with no visible means of supporting their bodies. It seems that they were kept float-

(Continued on page 132)

Mimic Atoms and Their Experimental Formation

By Eric R. Lyon, A. B.

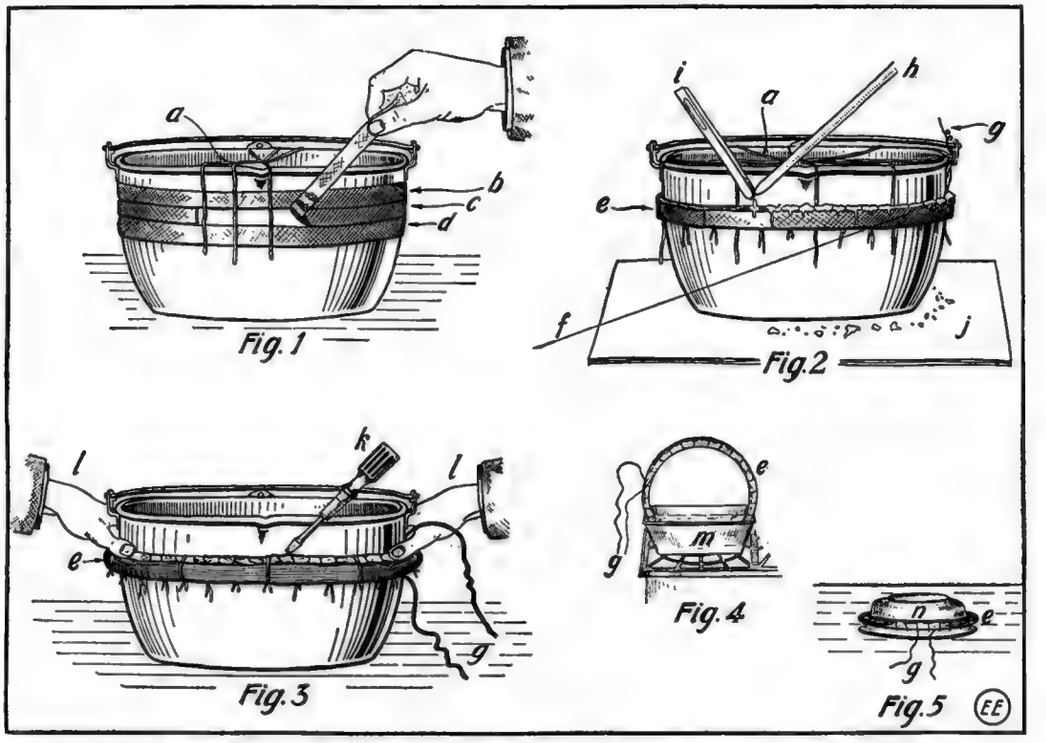
*[The editors are pleased to state that the subject matter of the original experiments constituting this paper have been discussed before the Physics Club of Chicago University; further that it won a fellowship for its author in the Rice Institute of Houston, Texas; that it was the subject of congratulation to Mr. Lyon upon the part of Dr. A. C. Crehore, of Columbia University, who has, with Sir J. J. Thomson, performed extensive and valuable work toward the establishment of the equilibrium-group-figure theory of the atom. Also commendatory notice was sent the author by Sir J. J. Thomson himself, through the courtesy of the assistant professor of physics in Rice Institute, who met the famous scientist during a visit to England and Cambridge University.]**

Part I.—Experiments.

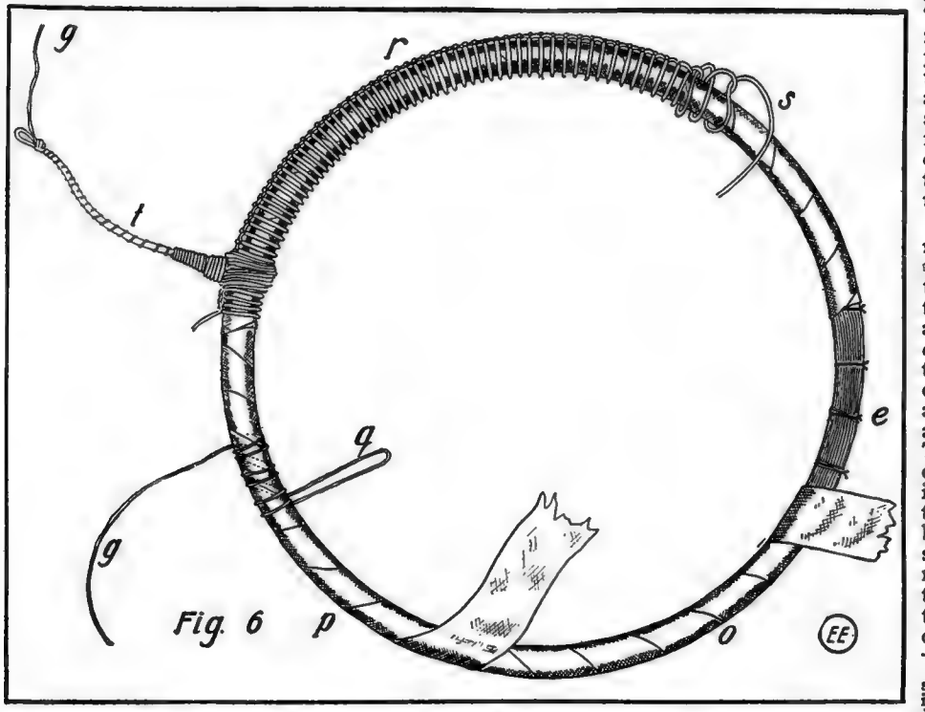
FORTY years ago saw the real nucleation of a theory which is destined to become one of the greatest contributions ever made to human knowledge. This is the electron theory which sweeps forward to the explanation of matter and to the solution of that question which foreshadows a new age and a marvel era in human progress—the question: "How can we release the almost unthinkably vast energy which is locked up in the atoms?"

Forty years ago on the eastern side of the Atlantic, attention was first being actively directed toward finding out the nature of cathode rays. There were some who thought these rays were ether waves, similar to radiant light, and others who believed them to be small particles of matter or corpuscles. We all know that the latter were right and that the cathode rays have since been proved to be little flying mites of matter, *the electrons,* which are at once *mites of matter* and at the same time extremely minute *charges of negative electricity.*

Forty years ago on the western side of the Atlantic a work was being done which could not at that time have been seen to have had even the remotest bearing on cathode rays, or upon the only dimly foreshadowed electrons; much less upon the then undreamed of problem of the electronic constitution of the atoms of matter. However, the work was upon the constitution of matter, not in its atoms, but in its crystalline forms as composed of atoms. Prof. Alfred Marshall Mayer of the Stevens Institute of Technology at Hoboken, N.J., was investigating the elasticity of metals. This investigation led him into the study of crystals, because the elasticity of metals is due to their crystalline composition. His study of crystals led him to inquire why the atoms in a crystal (for example, the cube of common salt) should arrange themselves in a regular order or "space-lattice," such that in each group of neighboring atoms the form of the completed crystal may be seen, and such that the latter completed crystal is built up from an original simple group of the type described—wherein an atom occupies and defines each of the several corners or vertices of the crystalline form—simply by the addition of successive parallel layers of atoms to the original crystal faces.



Showing the Various Stages Gone Thru in Winding the Submersible Magnet Coil.



How the Coil, Which Is to Be Submerged in a Tank of Water, is wrapped With Tape and Cord.

To answer that question Prof. Mayer magnetized a number of sewing-needles, thrust them through corks, and floated them upon a basin of water so that all of their North magnetic poles pointed *upward* and so that all of their South poles pointed *downward.* Having all of their like poles together, the little floating magnets hastened to magnetically push away from one another and to seek the farthest distance apart, which was at the wall of the basin. To counteract this expansion of the group, due to the mutual repulsions of the floating magnets, he held vertically a short distance above the center of the basin a large bar magnet with its south pole down. The south pole of the bar magnet attracted the north poles of the floating magnets so that the group was made more compact and so that the floating magnets were so close to one another that their mutual repulsive

* Adapted from the author's paper, "An Extension of Professor Mayer's Experiment With Floating Magnets," published in the "Physical Review," issue of March, 1914. Specially prepared by the author for THE ELECTRICAL EXPERIMENTER.

forces exactly balanced the attraction of the bar magnet. When this had occurred Professor Mayer observed that the floating magnets always arranged themselves geometrically and in concentric rings about a central member, which might consist of one magnet at the center and inside of the innermost ring; or of two magnets, one on either side of that center and equally distant from it; or of three magnets forming a little triangle around the center; or of four magnets forming a little square around that center. The groupings so obtained are practically the same as those shown in Fig. 17 (Part II of this paper). Professor Mayer regarded them as crystals in which the floating magnets take the place of atoms; the mutual magnetic repulsions, of atomic mutual repulsions, or reboundings due to heat quiverings; and the centrally attracting bar magnet takes the place of the force of cohesion which holds the crystal together.

We will not further concern ourselves with this theory of crystallization except to note that the "space-lattice" system of atomic arrangement in a crystal which Mayer sought to explain, has since been proved in form, although not yet explained, by the experiments which have very recently been carried out in the reflection of X-rays from crystal faces.

In the development of the electron theory there was to come the application of Professor Mayer's experiment to the explanation of a much more minute and much more wonderful crystal than Professor Mayer had anticipated. Sir J. J. Thomson in a paper published in the *Philosophical Magazine*, 1904, and in his "Corpuscular Theory of Matter" was the first to give definite statement to this new electronic crystallography of the atom and to employ Mayer's experiment in explanation of an arrangement of the electrons within an atom which must give to the latter the periodic character of its properties and especially of its valencies. It was observed that Mayer's groups (See Fig. 17, Part II,) were periodic in structure; i.e., that a certain form of strcture, say the triangular structure having a small equilateral triangle at the center of the rings' system, would repeat itself after an interval of other kinds of structure, and would be again repeated after another interval of other kinds of structure; each repetition embodying essentially the preceding example of the particular structure, but with the addition of another ring. As we said, periodicity in properties is an extremely important feature in the family of atoms and so Mayer's experiment has come to have a most peculiar significance in the atom theory.

We will now take up the construction of a form of Mayer's apparatus, which is an improvement on the original form, permitting the experimenter to obtain much larger and more beautiful groups than was possible with the use of a suspended bar magnet. Any one will be able to construct this simple apparatus and to actually make for himself the experiments which are possible with it. The construction details may be varied to suit the experimenter's convenience. They are such as were actually followed by the author in making the apparatus described.

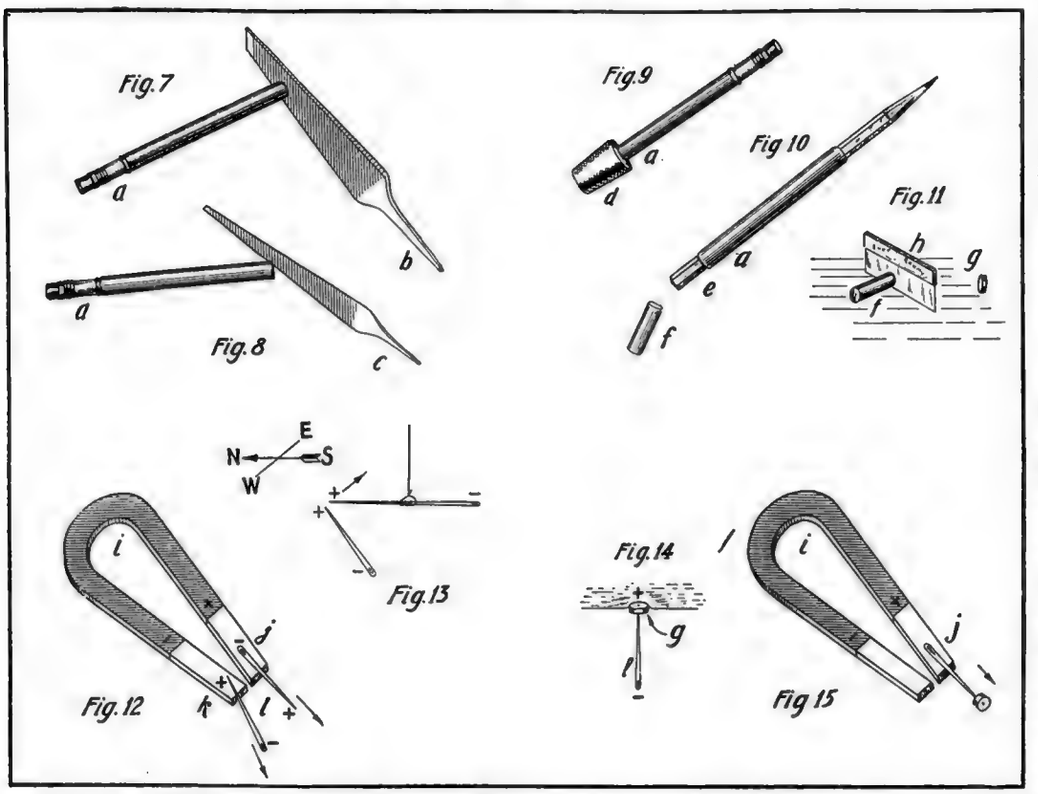
The materials to be purchased are:

2 dry cells, @ 35c.	cost, 70c.
1 roll. ¾ in., electrician's black friction tape	cost, 25c.
1 lb. No. 26 D. C.C. magnet wire	cost, 70c.
1 small horseshoe magnet (at a 5 and 10c. Store)	cost, 10c.
2 packages No. 10 sewing-needles ("Sharps"), @ 5c.	cost, 10c.
1 doz. fine grade smooth white, 1 in. corks	cost, 5c.
1 box "Parowax" paraffin	cost, 10c.
2 balls, 1/16 in. wrapping cord or marline, @ 5c.	cost, 10c.
1 stick of sealing wax	cost, 5c.
1 magazine-pencil of the kind consisting of a short brass tube having a removable stub-pencil inserted in one end and a pen and eraser in the other	cost, 5c.
Totol approx. cost	$2.20

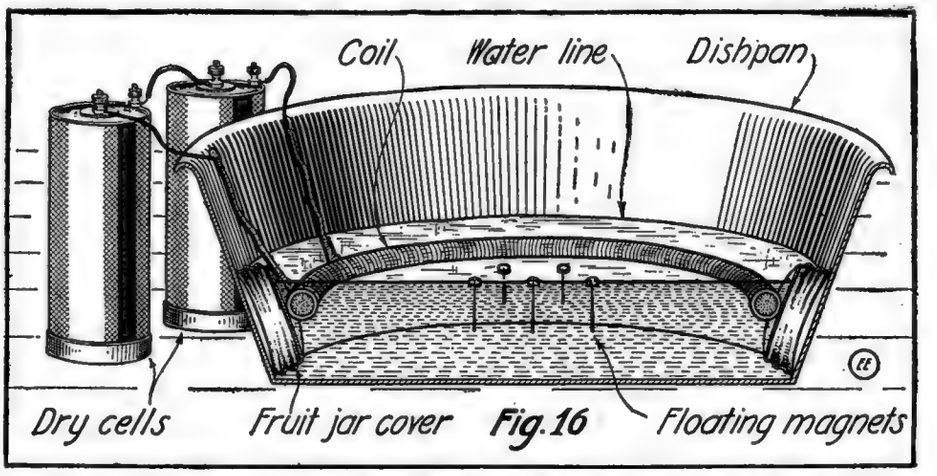
Tools and utensils required, but which are kept in any house and kitchen, are a pair of pliers, a screw driver, a stove poker, a good fire of coals in which to heat the poker, a kitchen range or gas stove, a flat file and a triangular file, a safety-razor blade of the "Ever-Ready" type, an ordinary tin (iron) wash basin, a tin (iron) dishpan about 13 in. bottom diameter, 4 fruit jar covers, a bread pan, size, top 10½ in. by 6½ in., depth, 3½ in.; an 8 quart (preferably aluminum) preserving kettle, top diameter, 11¼ in., depth, 6 in.; some cotton cloth or "domestic" to be torn in strips; and some heavy thread, No. 30 linen, or twine.

Fig. 1. Carefully wrap three lengths of tape, b, c, and d, side by side parallel to the top and around the kettle as shown. Strip off the middle length c. Cut twelve pieces of twine, each two feet in length. Arrange these, a, over the top of the kettle so that the ends hang evenly to about six inches down the side of the kettle and so that they are equally spaced around the kettle. Where the twine ends pass over b and d, press them against the sticky surface of b; allow a little slack to fit in c, and press against d. The coil of No. 26 wire will be wound in c and the pieces of twine will be used in binding the coil. Tie heavy wrapping cords around the kettle

(*Continued on page 138*)



Construction of Cork Disc Cutter and Method of Magnetizing Steel Sewing Needles.



Appearance of Magnet Coil in Tank, Also Batteries and Floating Magnetized Needles.

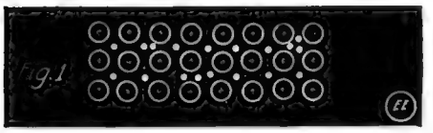
The Marvels of Modern Physics

By Rogers D. Rusk

Assistant Instructor in Physics, Ohio Wesleyan University

Important Electric Phenomena.

THE simplest electrical phenomena are often the most difficult to explain, and we are apt to take the more common-place of them for granted, without seeking an explanation. For instance we



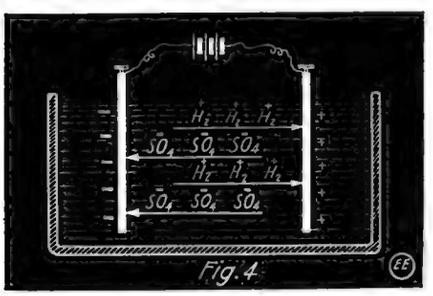
Arrangement of Free Electrons in a Conductor.

are as familiar with electricity flowing in a wire as we are with water in a pipe, but are we as familiar with the *exact nature of the current?* Although the latter is often used to explain the former, in so doing we only draw an analogy which aids us in visualizing the action, and which adds nothing to our knowledge of its nature. In seeking the true solutions of such problems we are brought to a realization of the close relationship existing between different natural phenomena, and we recognize more clearly the fundamental character of electricity.

Electrical phenomena are those occurrences which are caused or brought about by electricity. Of such there are many and their range is indefinite, extending from magnetism and ionization even to that natural phenomena of the polar skies, the aurora.

A battery or dynamo acts as a force pump in forcing an electric current along a conductor. According to the latest theories there may be a number of free electrons in a conductor (Fig. 1), at any given instant, due to the fact that electrons frequently gather sufficient kinetic energy to enable them to break away from their respective molecules. It is a stream of these free electrons that constitutes a current, and we may consider electrical resistance to be due to the friction opposing the motion of these particles. In this theory the existence of the free electrons has been assumed, but their presence can be proved in any metal by heating, and subjection to ultra-violet light. The only drawback is that one is likely to imagine the current as something quite material within the wire. In reality it is more as Steinmetz once said to a surprised newspaper reporter "not in the wire itself but in the ether about it." This is truer than at first seems, for the energy of the current resides in the field of strain about it, and it is this moving field which constitutes the current.

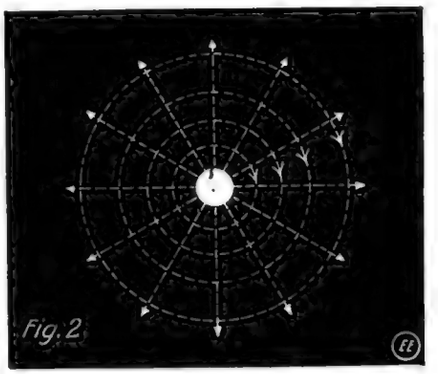
Every moving charge of electricity car-



How Electrolysis Is Possible by the Migration of Minute Electric Charges Between Two Electrodes.

ries with it a double field, as shown in Fig. 2. The straight radial lines represent the *electrostatic field,* while the concentric circles represent the *magnetic field.* Although existing together, they are distinct and at right angles to each other.

This immediately suggests the close relationship existing between electricity and magnetism, and leads us to conclude that even the electric unit—the *electron*—may produce a magnetic field when in motion. Langevin and Weiss have developed such a theory, which makes every molecule a magnet due to the polarity given it by its rotating electrons. Such an elemental magnet is shown in Fig. 3. In soft iron these elemental magnets are in neutral groups, but when magnetized they arrange themselves with like poles pointing in one direction. In non-magnetic materials, the polarity of the molecules has either been destroyed by opposing electrons or the neutral groups can not be broken up. The fact that the necessary elements are present is proved



Lines of Force About a Moving Electric Charge.

by the well known Heusler alloys which are magnetic alloys formed by the combination of non-magnetic materials.

The passage of a current through a conducting liquid is attended with results quite different than in a solid conductor. In the

Showing Difference between Propagation of Electro Magnetic Wave, by Moving Electron Slowly and Quickly.

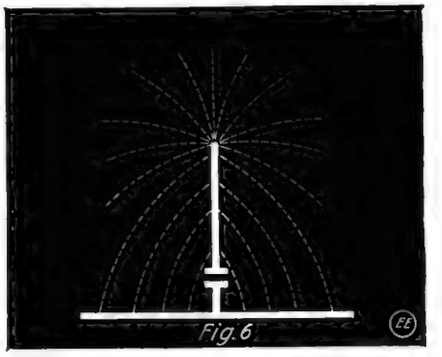
first place, a conducting liquid has striking characteristics of its own. It is ionized; that is, its molecules have divided into charged particles or ions, and these, though neutralizing each other, are free to move about. In the second place an imposed current causes a separation of these charges. Thus, as in the case of sulphuric acid (H_2SO_4) the ions H_2 and SO_4 are formed in solution, which are positive and negative respectively. The current causes a motion of these particles as seen in Fig. 4, and so hydrogen is carried to one pole while the sulphate particles are drawn to the other. The fact that these quantities do not *appear* except at the electrodes suggests that they only exist as true H and SO_4 after having given up their respective charges to the electrodes. This same phenomena of ionization is seen in gases, and thus in matter in all its forms we see evidences of the forces of electricity. In the case of ionization, such a division of the molecules into charged particles has led scientists to believe that electricity is the connecting link between the atoms. This explanation of chemical affinity was proposed some time ago by Davy and Berzelius.

A chemical combination occurs only be-

Illustrating an Elemental Magnet.

tween two atoms each of which contains an unbalanced electron. When the union takes place the excess charge of one fills up the deficiency of the other and a complete neutral molecule is formed. Recently it has been thought that not only those interatomic, or chemical forces, but also the inter-molecular forces of cohesion and adhesion may be explained in a similar way. The force of adhesion which makes glue stick to wood, or the force of cohesion which makes the particles of glue stick to each other, are likely an interaction between pairs of electric charges acting through distances which are extremely minute, and depending to a degree on the geometric arrangements of the atoms. A complete theory must wait until our knowledge of the atom is more definite.

More interesting than this to the wireless experimenter is the origin of the electric ether wave. Doubtless many who are familiar with all the apparatus extant have never stopped to think just how these waves are generated. Our present conceptions of light and Hertzian waves are largely due to J. Clerk Maxwell, the mathematical physicist, who suggested that these waves were electro-magnetic disturbances. In order to understand this, let us remember that the *moving electric charge carries a double field with it.* In the case of an alternating current, the electron moves first in one direction and then in the other, or it oscillates back and forth, and the coincident motion of its electric and magnetic fields produces a disturbance of electro-magnetic nature in the ether. This is an electro-magnetic wave. How this wave is propagated may better be shown by taking the example of a single electron and considering only a single line of force. Now if the electron is moved a little to one side as indicated in Fig. 5, the whole line will not all move at



Lines of Force About a Radio Antenna.

once, owing to the inertia it possesses. The part nearest the electron will move first and

(*Continued on page 130*)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Manager, H. Gernsback

Radio League of America News

AS evidence of the steady growth of the Radio League of America, the following letter from Captain W. H. G. Bullard, U.S.N., is reproduced, in which acknowledgment is given of the receipt of 596 names of radio amateurs, forwarded by Mr. H. Gernsback, manager of the R. L. of A. In this way the Government authorities in charge of the United States Radio Service are put in touch with all bona fide experimental wireless stations throughout the land. This is of paramount importance in the event of war as many of these amateur stations are capable of handling official radiograms very expeditiously. This fact was forcibly brought out by the admirable work accomplished in relaying a radio message clear across the continent through a chain of amateur stations on the night of February twenty-first last. This remarkable feat was described with photos of the relay stations, in the May number of *The Electrical Experimenter.*

The Rholphakapa Radio Club of East Liberty, Ohio

A great many radio amateurs are under the impression that if the location of their station is once known to Uncle Sam, they are then in a position to be called on for military service if war should come. Such is not the case, however, and although during a state of military rule any amateur station may be confiscated by the Government, the owner thereof is not compelled to operate the station unless he desires to do so. It is gratifying to learn that a large number of those joining the ranks of the *Radio League of America* fraternity are also signifying their willingness to serve their country in time of national peril, by signing the blanks distributed by the R.L. of A. or by the superintendent of Radio Service, Radio, Va.

The letter cited below is worthy of a second reading by all patriotic and law-abiding amateurs. It was sent to the superintendent of Radio Service and has created a profound impression on the officers in charge. Let some of our Radio Club members write also, explaining the scope and facilities of their organizations to Captain Bullard. Following is the Atlanta Radio Club letter. Note the spirit of cooperation manifested therein:

COLLEGE PARK, GA.

DEAR SIR: I would like to give you a few facts about the Atlanta amateurs. As president of the Atlanta Radio Club, it is my duty to see that you do not get a mistaken impression of us.

I have one of the oldest stations in this section and have watched with much interest the increase of the number during the last two years. At first I could hear only one or two amateurs. The number commenced to grow, and soon interference became a problem. By this time most of us knew each other and, being congenial, we decided to band together and discuss our problems.

There were about 10 of us to start with. We secured the use of one of the small anterooms of the Carnegie Library Building and there held our first few meetings. The club grew rapidly. The small room was soon so crowded that we had to seek larger quarters. Several of our number who were members of the local Y.M.C.A. obtained permission to use a large room on the third floor of the 10-story building. We have held our meetings there on alternate Saturday nights since last summer. A temporary aerial has been erected on top of the building and we use it for receiving tests.

After our constitution was drafted we proceeded to draw up a set of operating rules. These rules consisted of the Government Radio Service regulations and a few which dealt with the local conditions. In addition to the usual club officers we elected a club radio inspector, whose duty it is to enforce these regulations. It is also his duty to visit each station once every 60 days for the purpose of suggesting any improvements he thinks necessary.

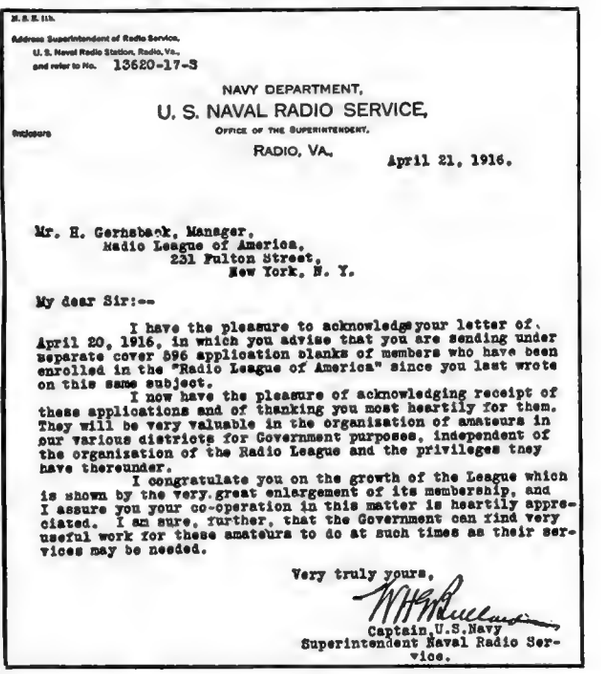
We decided that the objects of our club should be to promote interest in radio communication and to increase knowledge and operating efficiency. To promote these objects, we have decided to rate each member according to the percentage he makes on competitive examinations to be held every three months. These examinations will be very similar to the Government examinations as given to operators. They will consist of questions on the radio laws and regulations, questions on the theory and operation of the apparatus, and an operating speed test. We believe that by creating a spirit of rivalry among the members the interest will be stimulated and operating efficiency increased.

We want you to understand that Atlanta is as alive "wirelessly" as she is in other respects. During "electrical prosperity week" last December we were invited to enter an exhibit in the electrical show. We realized that this was beyond the scope of the average wireless club, and quite an undertaking for so young an organization. However, after discussing the matter we decided that it would be beneficial both to ourselves and to the public at large. Luckily we were allotted a space right beneath a skylight. Some of our energetic and enterprising members obtained permission, and erected an aerial on top of the 17-story building, on the ground floor of which the show was held. Thus it was that we were able to have a station in actual operation in the exhibit. Several of the boys were always present to explain the mysteries of wireless to the eager spectators. Taken altogether, the venture was a glorious success. The Atlanta newspapers all gave us good writeups and we secured many new members.

The probable reason for the late start of wireless in this vicinity is that there are no Government or commercial stations within 250 miles of Atlanta. In order to hear anything at all the first amateurs had to have comparatively large aerials and very sensitive instruments. Until recently these instruments were beyond the reach of all but the wealthy experimenters. (It is a curious fact that I have noticed that rich amateurs are few and far between.)

As we are so far beyond the zone of interference, most of us use transmitting waves somewhat over the limit prescribed by the Government. We do this knowingly, but we feel that we are still obeying the spirit of the law, which is to prevent interference with Government and commercial stations. If we had the faintest idea that we were

(*Continued on page 132*)



Address Superintendent of Radio Service,
U. S. Naval Radio Station, Radio, Va.,
and refer to No. 13620-17-S

NAVY DEPARTMENT,
U. S. NAVAL RADIO SERVICE,
OFFICE OF THE SUPERINTENDENT,
RADIO, VA.,
April 21, 1916.

Enclosure

Mr. H. Gernsback, Manager,
Radio League of America,
231 Fulton Street,
New York, N. Y.

My dear Sir:--

I have the pleasure to acknowledge your letter of April 20, 1916, in which you advise that you are sending under separate cover 596 application blanks of members who have been enrolled in the "Radio League of America" since you last wrote on this same subject.

I now have the pleasure of acknowledging receipt of these applications and of thanking you most heartily for them. They will be very valuable in the organization of amateurs in our various districts for Government purposes, independent of the organization of the Radio League and the privileges they have thereunder.

I congratulate you on the growth of the League which is shown by the very great enlargement of its membership, and I assure you your co-operation in this matter is heartily appreciated. I am sure, further, that the Government can find very useful work for these amateurs to do at such times as their services may be needed.

Very truly yours,

Captain, U.S.Navy
Superintendent Naval Radio Service.

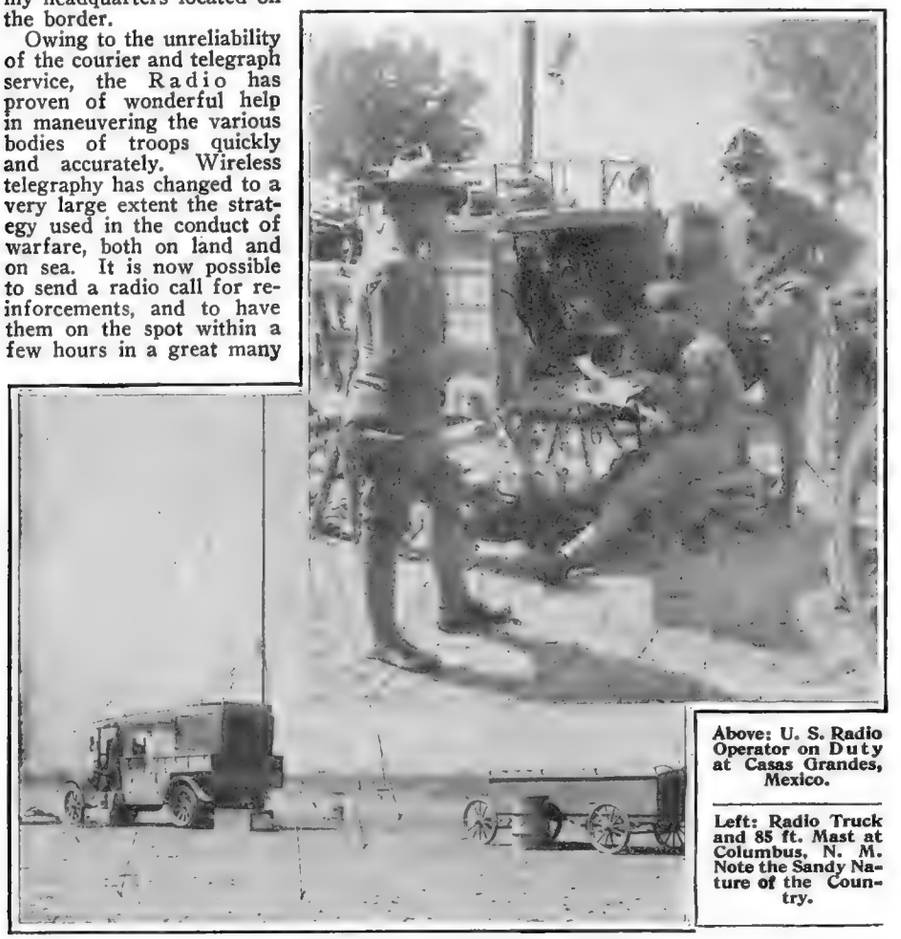
United States Signal Corps Use Radio In Mexico

THE accompanying illustrations depict the excellent portable Radio sets in use by the United States Army Signal Corps during the expeditionary campaign n Mexico. The particular apparatus is that in use at Casas Grandes, Mexico (right hand photo). The Radio operator is receiving Radio messages from the Mexican border line. Many important military despatches are sent back and forth from the expeditionary forces and the army headquarters located on the border.

Owing to the unreliability of the courier and telegraph service, the Radio has proven of wonderful help in maneuvering the various bodies of troops quickly and accurately. Wireless telegraphy has changed to a very large extent the strategy used in the conduct of warfare, both on land and on sea. It is now possible to send a radio call for reinforcements, and to have them on the spot within a few hours in a great many instances, whereas in previous wars it very often required one-half a day or a whole day, and even more, to get a message through.

The illustration at the left portrays the powerful Radio station in use by the United States troops at Columbus, N.M. This outfit is mounted on a large automobile truck and is of sufficient power to serve the army headquarters' staff, even though messages are to be transmitted several hundred miles. The demountable aerial mast rises above the arid, desert-like country to a height of 85 feet. So expert are the signal corps members in unpacking and setting up this apparatus that the whole operation requires but a few minutes.

Most of these radio sets for portable work utilize a gasoline or kerosene oil engine which drives a 500 cycle A. C. Generator. This gives a high pitched spark note which is heard the best in the receivers, especially under tropical and heavy static conditions.



Above: U. S. Radio Operator on Duty at Casas Grandes, Mexico.

Left: Radio Truck and 85 ft. Mast at Columbus, N. M. Note the Sandy Nature of the Country.

PHONOGRAPH CODE-PRACTICE RECORDS THE LATEST.

Wireless telegraphy, especially in England, has become such an important consideration that the British Marconi Company has developed a complete set of records, corresponding to those used on the regular disc type talking machines, each record containing an excellent assortment of code practice in dots and dashes. They were recorded by having an expert operator transmit signals on the specially devised apparatus, while the talking machine was in operation. The present set of records comprise six double-sided disc records, containing instructions for both the beginner and the advanced student. Each side gives from 3 to 4 minutes' instruction at the usual speed at which the record is run; the complete set thus giving up to three-quarters of an hour of first-class receiving practice. This scheme possesses many important advantages over others now in use, and any part of the record is available for instant reproduction, whenever the operator or student may so desire. Moreover, the speed at which the record is run can be controlled to suit any student.

The first record, intended especially for beginners in the art, contains on one side the complete Morse code with all standard abbreviations and punctuation signs. On the reverse side of this record difficult letters such as C, Q, Y, etc., are picked out, and they occur several times in succession; then there follows a sentence very slowly and deliberately, containing several letters of the alphabet. The second disc contains on one side numbers, at a speed in the neighborhood of about ten words per minute, and on the other side, similar matter which has been transmitted at a speed approximately fifty per cent. faster. Owing to the possible regulation of the speed in any standard talking machine, a record whose normal velocity yields 10 words per minute, may be adjusted as to speed so as to give any reproduction at a speed of from 8 to 12 or 13 words per minute.

Both sides of the third record contain dummy messages properly numbered, timed and counted exactly similar to those sent between government or commercial stations and to ships at sea.

Record No. 4 contains stock exchange terms, fractions, etc. On the reverse side of this record is found code words, ciphers, etc., normal transmission being at the rate of 20 words per minute.

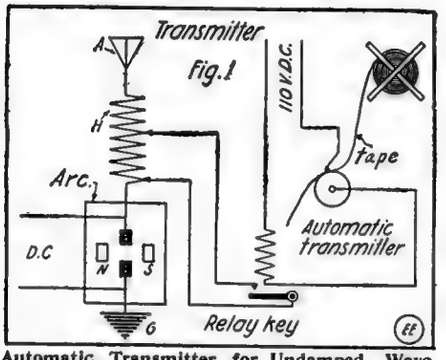
The fifth record contains a collection of messages of varied degrees of difficulty, such as are encountered in the course of an ordinary day's work, and, correspondingly, the speed at which these are transmitted is 25 words per minute. The reverse side of this record contains a miscellaneous assortment of French, Spanish and Italian messages in code, at a rate of 25 words per minute.

The sixth record is perhaps the most interesting of the whole series and without doubt the most valuable. This remarkable record contains signals sent out by two distinctly different transmitters on slightly different notes. The home student who has not had access to a wireless installation will now be in a position to hear just what signals sound like when "jammed" and will at the same time be given exceedingly favorable preparatory instructions for the time when he takes up his duties on board ship. This "jamming" record contains on one side "press," transmitted at a normal speed of 25 words per minute, and "jammed" or interfered with by similar matter transmitted at a slightly lower speed. On the reverse side there is given mixed messages at the rate of 25 words per minute, also "jammed." A student can gain a large amount of practice with this one record, as it often becomes necessary for an operator to read a note through considerable interference of static and one or more neighboring stations which endeavor to deluge him with a multifarious accumulation of dots and dashes, with a few splashes of static thrown in for good measure.

High Speed Radio Telegraphy

By C. V. Logwood

THE first attempt toward perfecting a rapid transmission system for radio telegraphy was that made by the Poulsen Wireless Telephone and Telegraph



Automatic Transmitter for Undamped Wave Station.

Company of San Francisco, California. In June, 1910, the company erected two experimental stations, one at Sacramento and the other at Stockton. These stations were erected for both radio telephone and telegraph work and were especially located at these points so that atmospheric interference would be minimized so far as possible.

The initial high speed radio telegraphic system was installed and supervised by Mr. Schow of Copenhagen, Denmark, with Mr. V. Poulsen as chief engineer. The stations were in charge of Mr. Albertus and Mr. Jensen, both of Denmark.

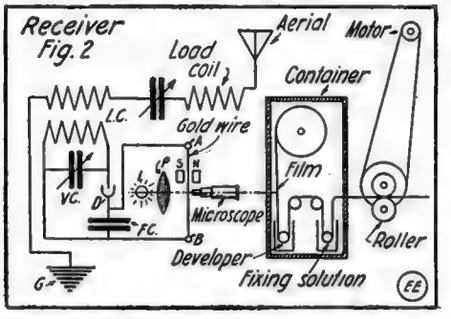
The first system tried out employed a tape transmitter, as shown in Fig. 1. The tape consisted of a perforated sheet of paper containing the (code) message and this was passed between two contacts, one of which was a roller, as perceived. The tape and the two contacts operated a relay, which in turn controlled the antenna wavelength. At the other end the receptor consisted of a standard form of circuit, in which the telephone circuit was linked to a fine gold wire A-B, Fig. 2. This was about four inches long and had a resistance of about 360 ohms. The wire was placed between the poles of a powerful electro-magnet NS, which were excited by 110 volts D.C. A condensing lens P was placed on one side of the gold wire, while in front of it was mounted a Nernst lamp L. The light developed by this lamp was focused on the wire. The light passing through the microscope indicated was caused to fall upon a moving photo film, as depicted at the right. It is then obvious that if the gold wire is made to vibrate it will cause the continuous ray of light to oscillate and thus a wavy image or line will be photographed on the film. The film, which moves continuously, passes through a developing and fixing chamber.

A great deal of experimental work has been conducted on this system, but it finally proved unsuccessful. The first defect that had to be eliminated was that of the breaking of the fine gold wire and the second was that the signals were not clearly recorded on the moving film. This latter was overcome by placing a small slit about 1/32"x½" before the film, so that the light received by it would be equally distributed. The other defect which had to be remedied was that of the detector. The first detector utilized was that having graphite in contact with galena. It is obvious from this description that any direct current impulse through the crystal detector would cause the gold wire to be attracted by the electro-magnet poles.

After extensive trials and research along this line, the experiments proved total failures, but the object was not entirely abandoned. Mr. Christensen of Copenhagen, noting the difficulties which were observed in the previous experiments, began to work on the problem, but after trying for a year without results, he decided to give some other engineer a chance to develop a high speed telegraphic instrument and finally Mr. Elwell, Chief Engineer, assigned the author the task of solving this interesting problem.

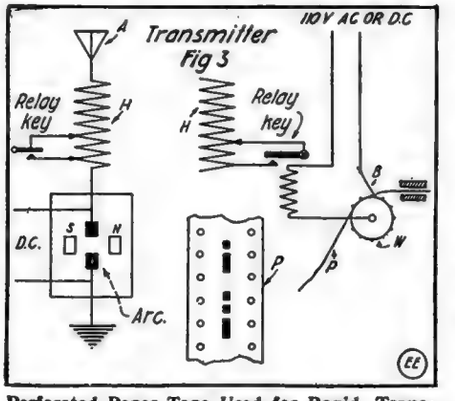
Complete installations were made at Los Angeles and San Francisco, using the last improved type of rapid transmitters and receivers. After six weeks of constant, laborious work it was demonstrated that the system was a complete failure.

The author had previously made some promising experiments with the telegraphone and microphonic relay, which had all the "ear-marks" of a new system. The following scheme was installed by Dr. De Forest and myself. At first a Wheatstone transmitter was employed for translating the perforated paper strip containing the (code) message into dots and dashes. It



Photographic Scheme of Recording Radio Messages.

consisted of a circular, toothed metallic wheel, as perceived at W, Fig. 3, which re-



Perforated Paper Tape Used for Rapid Transmission of Radio Arc Signals.

volved by means of a motor. Upon the surface of the wheel was placed a strip of paper. A fine brush contact B was then placed on top of the paper strip so that it made contact with the metallic wheel W, when a punched mark in the paper was under the brush contact B. The Wheatstone transmitter was connected to the relay, as indicated. Now it is quite evident that whenever the strip of paper traveled across the wheel that it would automatically operate the relay. The first problem encountered in this work was that of finding a proper telegraph relay, which would handle heavy currents at high speed. At last this was overcome by making a powerful, stocky key; one which would act instantly and at the same time withstand heavy amperages.

When the transmitter was finally perfected our minds turned to the development of a receiver which would record the high speed "incoming" signals. The problem was eventually solved by employing a tikker of my rotary type, to break up the sustained waves and then lead them to a three-step audion amplifier; a two-step one of the same type is depicted at Fig. 4. The highly amplified signals were then brought to a single sensitive receiver R. This was arranged against a microphonic transmitter M, the diafram of which was tuned to the receiver's diafram, and thus the greatest amount of sensitiveness was obtained. The microphone was connected in series with a battery and a small telephone induction coil C, Fig. 4, the secondary of which was linked to a telegraphone.

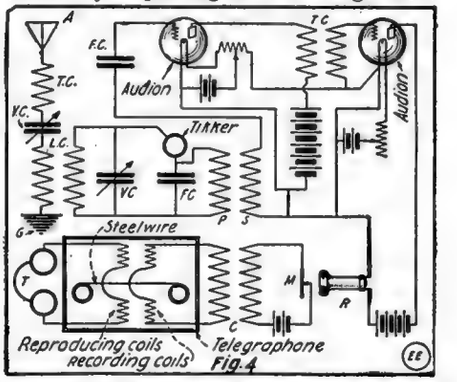
Owing to the coarse sounds produced by the tikker, it was impossible to receive signals having a speed greater than seventy-five words per minute. This was due to the following reasons: the signals coming in at seventy-five words per minute could be readily recorded on the moving steel wire of the telegraphone, but in order to reproduce them at normal (thirty or thirty-five words per minute) speed, it was necessary to run the steel wire slowly and in doing so the tone of the signals was not very clear. This resulted from the harsh sounds developed in the telegraphone receiver due to the slow speed of the moving steel wire. However, this was readily eliminated by employing a higher pitch than the tikker's "paper-tearing" note. The Federal Telegraph Company has operated successfully with this system for a whole season, but signals were transmitted at somewhat slower speed than seventy-five words per minute. Finally it was abandoned as this company installed several duplicate stations.

Apparatus for use in rapid radio transmitters and receivers are still in their infancy and there is a wide field of research for those who are interested in the commercial end of radio telegraphy, as it is patent that a great deal of money can be saved if an all around, thoroughly reliable system can be evolved.

WIRELESS GIVES BEARINGS.

A Bellini Tosi direction finder has been installed at the naval radio station at North Truro on Cape Cod. With it the bearings of a ship from the station can be ascertained by the radio waves and the direction can be found, affording a new aid to navigators in determining their position. In tests the direction finder has been found correct within about two degrees.

All merchant ships with wireless are requested by the Government to aid in the experiments whenever within range of the station by requesting their bearings from



Hook-up for Audion Amplifier and Telegraphone Recorder

the station and stating how such bearings check with the ship's observation.

HOOK-UP FOR UNDAMPED AND DAMPED OSCILLATIONS.

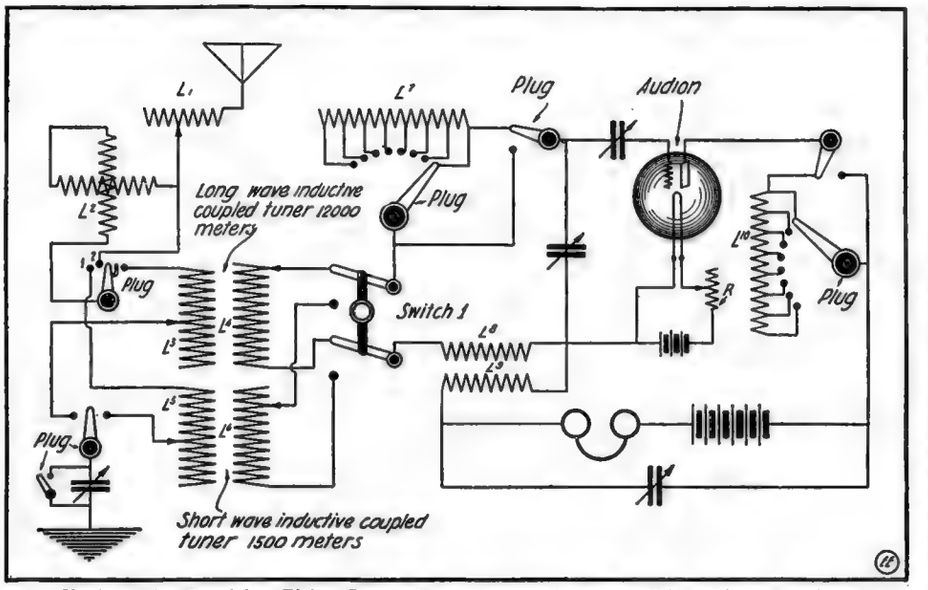
With this hook-up the writer has been able to copy Germany, and Honolulu, using an antenna of two wires 165 feet long and 50 feet high.

All contacts for plugs are spaced three inches apart except 1 and 2, which are spaced two inches from each other in order that the variometer may be either cut out of the circuit or left in (for the short wave lengths). The inductance coil L-10 is 28 inches long and 5¾ inches in diameter, wound with No. 28 S.C.C. wire. The coil L-9 is 5½ inches in diameter and 7 inches long, wound with No. 24 S.C.C. wire. The coil L-8 is also 7 inches long and 5 inches in diameter. It is wound with the same wire as coil L-9. Coil L-7 is 29 inches long by 5¾ inches in diameter, wound with No. 28 S.C.C. wire.

The primary winding of L-3 is 6 inches in diameter and 14 inches long, wound with No. 24 S.C.C. wire, and the secondary L-4 is 16 inches long by 5 inches in diameter and wound with No. 28 S.C.C. wire.

When switch No. 1 is thrown to the left and coils L-7 and L-10 cut out of circuit, amateur signals are picked up immediately. It is quite simple with this hook-up to change from the short to the long wave lengths, and moreover, but one audion detector is necessary to gain all the results here enumerated.

Contributed by HARRY Y. HIGGS, R.E.



Hook-Up for Receiving Either Damped or Undamped Waves with a Single Audion.

A GOOD EMERGENCY AERIAL.

During a recent storm my aerial blew down and on account of the condition of the weather it was impossible for me to go up on the roof and repair it. So I devised the following antenna and was agreeably surprised at the good results obtained.

I had in my cellar four feet of cardboard tubing measuring about four inches in diameter. I wound this with No. 18 bare copper wire (in the same manner as you wind an ordinary tuning coil). Having finished this I lined the bottom with the remains of an old hot water bag. The bottom was lined with the rubber so as not to be grounded when it was inserted over the top of the iron waste pipe, but with a little care this may be dispensed with. After exploring the roof for a suitable place I espied an old waste pipe. After placing the coil over it I connected it to my lead-in and was astonished to hear "Arlington" (NAA) as well as with my regular aerial which was one hundred and ten feet long.

Contributed by
ANDREW W. J. GALLAGHER.

Our navy needs wireless operators and electricians. The advancement is rapid. All men who enlist for this work are sent to the navy school for six months and are paid while under instruction.

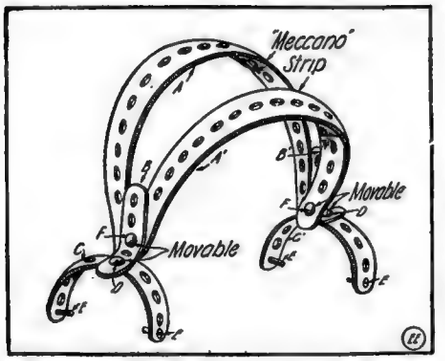
EMERGENCY TELEPHONE HEADBAND.

This headband, while easily made, is as serviceable as those which are more elaborate. It is very easy to adjust and can be used in an emergency to good advantage.

A and A′ are 12-inch Meccano strips, B and B′ are 2½-inch strips and C and C′ are 6-inch ones. Bolts and nuts D, E and F are the regular Meccano bolts.

First bend the pieces A and A′ as shown. Then bend C and C′, also B and B′, about ½ inch from the end. Put the pieces together as shown in the illustration. At D and F place a few small washers and clamp two nuts together so as to make these points readily movable. E and E are small bolts filed down to fit the recess in the receiver shell. The whole band may be enameled black or covered with leather after the adjustments have been made to give it a good appearance. To adjust, change the position of F. This headband is of the usual standard type. Contributed by

CECIL H. OSTERMERER.



A "Meccano" Headband for Your Receivers.

POCKET RADIO RECEPTOR WITH 60 MILE RANGE.

This is a real pocket receiving set; one that actually "receives." Using a 50-foot aerial, stations 60 miles distant have been heard, while by using gas pipes, beds, etc., amateurs within two and three miles are easily read.

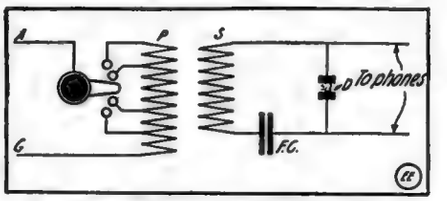


Diagram for Pocket Radio Set.

The set consists of loose coupler with taps, condenser, detector and 'phones. The tuning system is all attached inside and outside of an empty wireless receiver from which the magnets have been removed. The loose coupler consists of a primary coil (staggered winding) of 150 turns of No. 30 copper wire wound so as to fit tightly inside the empty receiver. Five taps of 30 turns each are taken off and brought to the midget switch points on the back of the 'phone case. The secondary contains 50 turns of No. 30 wire, with no taps, and fits inside the primary. The condenser fits inside the case also and consists of 36 square inches of tinfoil separated by paper and folded to fit the 'phone.

The detector is novel and consists of a fixed silicon element. That is, a piece of silicon about ¼ inch in diameter is ground flat on two opposite sides and clamped between two rods held by two binding posts. Over the crystal and the rods is placed a cardboard tube. See illustration. Contrary to general opinion, silicon is sensitive and used in this manner is permanent.

Through the two holes in the side of the 'phone two conductor cords are brought. One twin cord connects to the aerial and ground and the other to a head 'phone.

LONG WAVES WITHOUT A LOADING COIL.

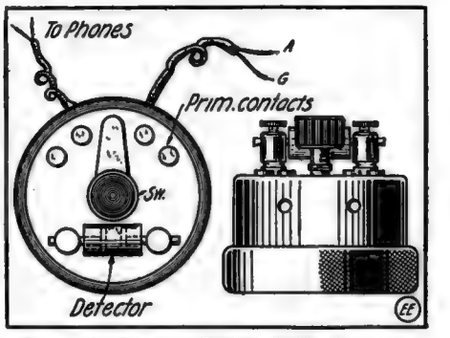
Any one possessing a loose-coupler may hear stations whose wave lengths are beyond the normal range of his tuner by connecting the primary and the secondary of the loose-coupler in series, leaving the closed circuit connections unchanged. Of course a certain amount of selectivity is sacrificed by this arrangement, but a loose-coupler connected in this way is more selective than a long wave tuning coil and cheaper than a receiving transformer plus a loading coil. With this connection the writer has been able to bring Wellfleet in very loudly on his receiving transformer.

Contributed by THOMAS T. HOOPER.

Thus the complete set consists of two 'phones, one containing the tuning apparatus and the other being used over the ear in the usual manner.

First connect all the leads of the coils, taps and condenser. Then put the coils in place and, lastly, the condenser. Screw the cap and diaphragm on to hold the "innards" in place. Wire as per hook-up and connect cords as indicated.

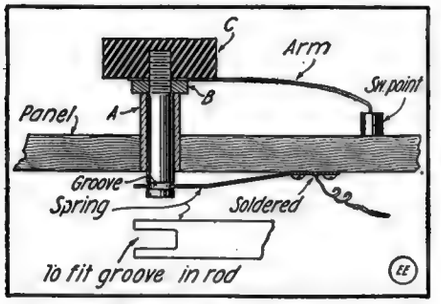
Contributed by EARL H. SWANSON.



Extremely Compact Pocket Radio Receptor.

A GOOD "TAP" SWITCH ARRANGEMENT.

One of the principal difficulties in constructing a good tuner, switch panel or



Efficient Design of Loose Coupler Switch.

other piece of electrical apparatus requiring a multiple point switch is to mount the knob on the shaft, and the shaft on the panel in a satisfactory manner. The shaft should be rigid and true, and yet turn freely.

The accompanying illustration shows the method evolved by the writer after considerable experiment, and adopted as the most satisfactory, and at the same time exceedingly simple to construct.

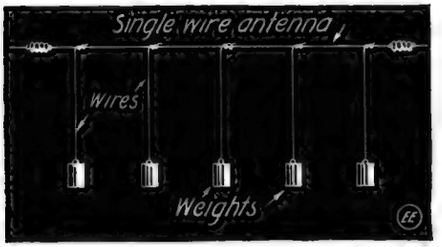
The knob shown at C is best made of Bakelite, hard rubber or black fiber. A hole is drilled nearly through from the under side with a one-quarter inch tap drill, and then tapped as deep as a plug or bottoming tap will go. A thin lock nut is made, as shown at B. A piece of one-quarter inch brass rod is threaded, as indicated, and cut off to the right length, which is determined by the size of the instrument and the taste of the builder. Close to the lower end a groove is turned or filed around the rod for the spring to fit in. This rod is held on the panel by means of the tube A. This may be a piece of three-eighths brass or fiber tubing with a quarter-inch hole, or may be a piece of the same size material with the hole drilled. This tube should be a tight fit for the hole in the panel, and the inside of the hole in the panel should be well soaked with glue before driving in the tube.

The spring, as shown in the insert, has a fork formed on one end to fit the slot, and is bent to pull in on the rod. The spring is fastened to the inside of the panel by screws, as shown, and the connecting wire is best soldered to it.

Contributed by C. S. ROBINSON.

IMPROVING THE SINGLE WIRE AERIAL.

I have found that when using a single wire aerial about two or three hundred feet long, the sending range is increased by suspending as many wires as possible from the single horizontal wire. These vertical



Improving the Single Wire Antenna.

wires may be slid along the horizontal wire by attaching small weights to the ends as shown in the sketch.

Contributed by J. W. HALLIGAN.

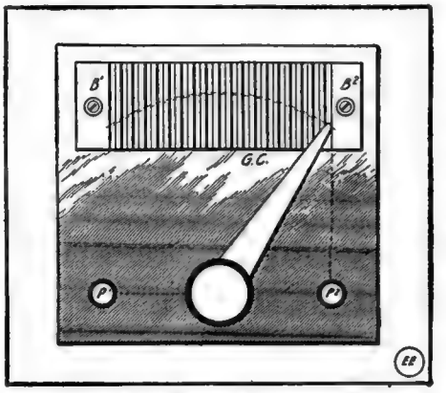
A HIGH-VOLTAGE BATTERY FOR AUDIONS.

The average high-voltage battery for the audion detector or amplifier consists of either flashlight batteries or dry cells.

The battery here described is a good deal cheaper than either of the above and, what is more, most any experimenter can readily make one.

First buy enough raw copper and zinc (any gauge will do) to make between 25 and 60 pieces of both copper and zinc, each 1½ inches by ¾ inch. The same number of sheets of the same size should be made out of common white blotting paper. The base should now be made of fiber, and fiber blocks should be made (B-1 and B-2), so that when fastened with screws near the top of the base the copper, blotter and zinc couples will just fit in between them. The tighter they are the better. The galvanic couples should now be put in place in this order: zinc, blotter, copper; zinc, blotter, copper, and so on until they are all fitted in place. Each couple yields about one volt. The voltage control knob should be mounted at the bottom of the base and a narrow, tapering, knife-edge switch blade attached to same. Five cents' worth of 10 per cent. solution of sulphuric acid should be obtained and applied to the blotters with a medicine dropper. The switch blade should only touch one element at a time.

An interesting experiment may be made by getting your friend to put the wires



Copper-zinc High Voltage Battery for Audions.

from the two binding posts on his tongue and then quickly turning the control switch on. He won't get hurt, but he will be considerably surprised.

Contributed by FRANCIS R. PRAY.

HOW TO FILE COPPER.

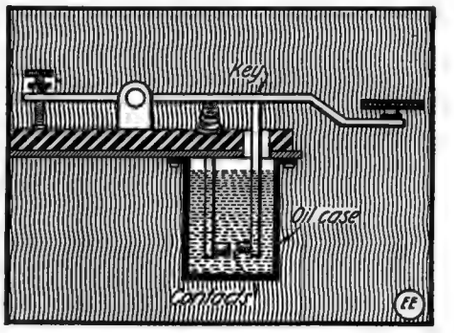
Mechanics are frequently called upon to file copper connections, in wiring switchboards particularly. When using a file on copper the teeth easily become filled or choked, making the file ineffective in a short time. There are two ways of preventing this, says Robert Oster in *Elec. Review and Western Electrician.* One is by using a little chalk on the file teeth; this prevents the copper filings from adhering and choking up the teeth. Another method is to use backward strokes of the file for the finishing touches.

If you expect to keep the wire on your tuning coil tight, place it away from the radiators. Heat stretches the wire.

AN OIL-BREAK KEY.

Herewith is an illustration of a key that is very useful for wireless work, and one that can be used with sets of one kilowatt capacity. When the common wireless key gets red hot at the contact points this can be done away with by having the contacts immersed in oil (paraffin or transil oil).

I hope this may help some amateurs who



Oil-break Radio Key.

are having trouble in keeping good contacts on thei keys.

Contributed by JAMES R. ALLEN.

WHAT A SPIRAL AERIAL CAN DO.

Regarding spiral inside aerials, I am sure there are quite a few amateurs who would like to own a receiving set, but hesitate because they do not like to erect an outside aerial, and I am certain that if the following directions are carried out successful reception will be accomplished:

The aerial is composed of about two pounds of No. 14 "Antenium" or other wire stretched along a piece of rope in a coil about 14 inches in diameter and the turns spaced about 3½ or 4 inches apart. The rope is insulated at each end with a porcelain cleat and also supported in the center in the same way.

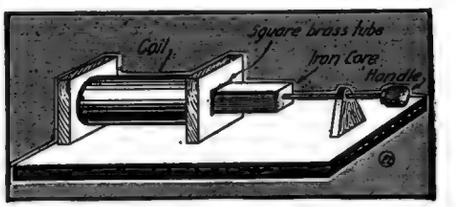
It can be located in the garret of any wood or brick dwelling, provided the roof is not tin and the lead-in wire runs on porcelain knobs to any part of the house; of course running this wire in as straight a line as possible.

The antenna should be at least 25 feet high and 50 feet long. All dimensions given herewith are the same as those used by the author, and with a three slide tuning coil 3,000-ohm head set, fixed condenser, variable condenser, galena detector, and loading coil Arlington can be copied every night during the favorable months of the year, as well as all the commercial and amateur stations in and about Detroit at all times.

Contributed by H. P. HARDESTY.

VARIABLE INDUCTANCE FOR TRANSFORMERS.

The drawing herewith and the description which follows is of a variable inductance to be used in transformer circuits, etc. Wind around a 1-inch square brass tube, 6 inches long, about 100 turns of No. 14 D. C. C. wire. Fasten this to a wood base and then construct a laminated sheet iron core that will slide in and out of the brass tube. The iron laminations may be riveted to form a compact core.



Finely Adjustable "Choker" for Transformer.

This can be done by hand or by means of a screw for fine regulation.

Contributed by CHASE HUTCHINSON.

THE CONSTRUCTOR

A Practical Portable Wireless Set

By Milton B. Sleeper

NOW that summer is in sight, the progressive radio amateur is making ready for experiments with portable equipment. Unfortunately, too many sets are made of extra, or discarded instruments. For this reason, the results which many experimenters have obtained were far from satisfactory. Although it is possible to receive a considerable distance with simply a pair of receivers and a detector, with a large aerial, practical work with portable apparatus requires a set of high efficiency. At the same time, the outfit must be simple, to be compact and easily carried. The set described in this article was designed for use with a single wire aerial, 150 to 200 feet long, 20 feet high at each end. This aerial will not emit a wave of 200 meters, but the spark-coil is so small that it will comply with the law. The complete apparatus, including the battery and carrying-case, weighs only fourteen pounds.

Fig. 1, Appearance of Completed Radio Sending and Receiving Set. Sending Range 3 to 5 Miles. Has Received 300 Miles and is Capable of Much Finer Work.

Sending Set. The general dimensions of the carrying case may vary slightly, but this set is designed for a standard size suit case, the cost of which is only $3.00. Fig. 1 gives a general idea of the appearance of the completed outfit. On the panel at the right are mounted the controls for the receiving instrument and the sending key. In Fig. 2, A is a galena detector; B, B the primary switches; C, the secondary switch; D, the buzzer-test switch; E, the variable condenser, and F, F, the binding posts for two pairs of receivers. As will be explained later, no coupling variation is needed. A buzzer and battery are mounted beneath the panel, Fig. 2. A fixed condenser is fastened inside at the back.

The left hand panel c rries the spark-gap, G, primary circuit ammeter, H, change-over switch, I, antenna and ground connections, J, while the vibrator of the spark coil, K, protrudes into the compartment allowed for the phones. In the case are the batteries and sending condenser. If it is desired, an auxiliary battery may be connected to the binding-posts L.

The wooden frame upon which the panels are fastened, is made of pine or white wood. When this set was built the pieces were cut from one long strip, 4 inches wide and ⅜-inch thick. Fig. 2 gives the length of the pieces.

Although binding-posts are provided at the left of the sending panel, Fig. 1, for the connection of an extra battery, a space is provided in the case sufficient for holding 6 flash-light batterys of 4½ volts each. These when *connected in parallel* have sufficient power to operate the spark-coil for a considerable length of time. It is more satisfactory, however, to carry a separate battery box holding 6 large-size dry cells. The ammeter is to register the current supply in the primary circuit and is always connected in series with the battery and coil. For convenience, the sending key is mounted at the right. It may be necessary to shorten the lever, but this really improves the action of the key.

A code chart, list of abbreviations, or any necessary information can be fastened to the cover. There is room enough to lay a pad of paper on the top when the case is closed.

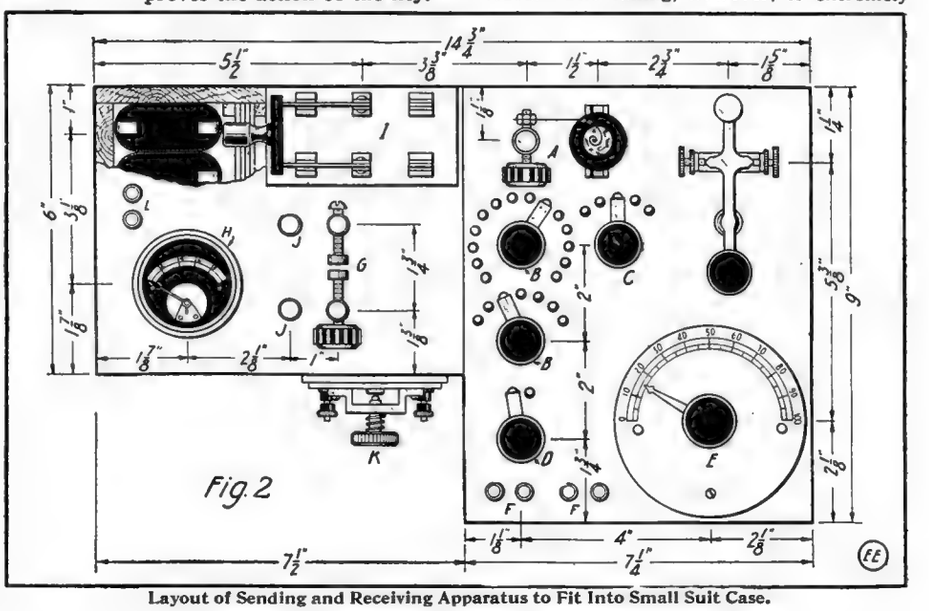
In communicating up to one mile, a half-inch coil is large enough. The coil used with this set is of the *Bull Dog* type. This is most convenient, as the tube enclosing the coil can be inserted through a hole in the wooden case. This leaves the vibrator screw where it can be easily adjusted.

A plate-glass condenser, C, connected in shunt to the coil, Fig. 3, greatly increases the sending range. Four glass plates, 5x3½ inches are needed. The three tin-foil plates are 4x2½ inches. Small wooden strips, ¼x¼ inches hold the condenser in place. It improves the insulating qualities to coat the complete condenser with wax.

The spark-gap, G, is of the conventional type. A thread in the front binding-post makes the adjustment finer than when the movable electrode simply slides in and out. Ordinarily, the gap is not more than 1/32 inch long, as the condenser and the connection of the aerial and ground greatly reduce the usual ½-inch spark developed by the coil.

All wiring, both for the sending and receiving instruments must be of rubber-covered, high-tension cable, to prevent any sparking, due to the small spacing between the wires in the case. A relay, in series with the battery circuit can be used to disconnect the receiving instruments while sending. This requires an anchor gap in the ground lead. A double-pole, double-throw switch, Fig. 1, is more satisfactory, however. A hard rubber auxiliary base was used with this set, although it is not necessary.

Receiving Set. The most unusual part of the receiving apparatus is the loose-coupler. No variation in the coupling is provided. The tuning, however, is extremely



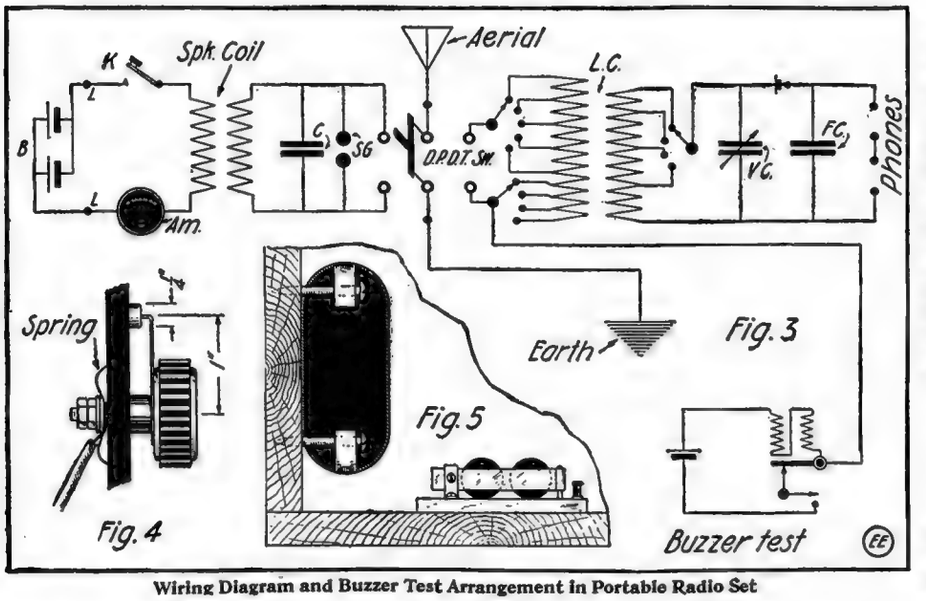
Layout of Sending and Receiving Apparatus to Fit Into Small Suit Case.

sharp, while the signals are much louder than with an ordinary receiving transformer. Unlike most loose-couplers, the primary coil is on the inside. This is composed of a single layer of No. 26 single cotton-covered wire, wound on a tube 5 inches long by 3 inches in diameter. Fourteen taps are taken off, beginning at the left, every fourteen turns. Then seven taps are taken every two turns. All wires go to the inside of the coil, through small holes in the tube. Antenna and ground connections are made to the switch blades.

easily adjusted, and does not jar out quickly.

Some form of fixed condenser, fastened inside the case, must be connected across the receiver binding posts. Connections are provided for two pairs of phones. For only one pair, connections are made to the outside posts.

Fig. 5 shows the buzzer test. A flash-light battery, held by two screws under the spring contacts, supplies current for the buzzer. A high pitch is most easily obtained by gluing a sliver of wood under the con-



Wiring Diagram and Buzzer Test Arrangement in Portable Radio Set

A layer of writing paper or empire cloth, over the primary winding, separates it from the secondary. The same size wire is used for both coils. This may seem unadvisable, if the two circuits are to be brought to resonance. As a matter of fact, the variable condenser in shunt with the secondary makes up for the capacity added to the primary by the antenna. Only five taps are taken from the outer coil; sharp tuning is made possible by the variable capacity. A layer of heavy empire cloth over the coil protects the wire from rubbing against the connections and carrying-case. In the photograph, the upper left-hand switches are for the primary, while the right-hand switch is for the secondary.

Fig. 4 shows a new method of fastening the wires in a simple way, to prevent the connections from being twisted off by the constant turning of the handles. The wire is formed into a loop to fit around the shaft. Over this a piece of spring brass, bent in the shape of a bow, is placed. This spring serves the purpose of holding the contact against the switch points, and of protecting the connection. Two washers, under the nuts, make the action smoother. Fig. 2 gives the dimensions for the switches.

A rotary variable condenser gives the close tuning adjustment of the secondary circuit. This is an ordinary 43 plate type, with the case removed. A hole in the hard rubber panel admits the plates; the instrument is held by machine screws from beneath. The tuning is so sharp that a slight variation of the capacity will bring a station in or out.

The detector used with this set is extremely simple, although a... type can be used. It consists only of an adjusting handle, held in a binding post. At the end of the shaft a fine piece of phosphor bronze wire is clamped by two nuts. The detector cup, holding a piece of *"Radiocite"* rotates in a trough-shaped slide. This detector is

tact of the armature. The two-point switch controls the buzzer-operation.

OPERATION.

If a battery is put in the case, it is only necessary to carry, exclusive of the set, two hundred feet of aerial wire and some form of ground connection. An excellent counterpoise consists of ten wires, twenty feet long, fastened together so that they can be extended radially. The ground connection is taken from the center. If the set is used on moist earth, however, an iron rod, driven three feet into the ground, will be satisfactory. A reel can be used to hold the two hundred feet of aerial wire and the counterpoise. If possible, the aerial should be stretched between trees; poles are awkward to carry. With a two hundred foot aerial, twenty feet high, the government station at Radia, Va., was easily copied from New York City, a distance of 275 miles. Longer distances, however, can be covered. The one-half inch ... rk coil is large enough to send two miles, or even five to ten miles if an audion detector is used at the other station. The weight of the set, fourteen pounds, makes the set extremely portable. The cost of the entire outfit was only fifteen dollars, low enough to bring it within the reach of every wireless club and Boy Scout troop. Even though the set requires a little careful workmanship, it is far more practical than the little pocket sets, of which experimenters are so fond.

[Editor's Note: We will be glad to furnish any experimenters or wireless clubs with the names of the manufacturers of the individual or complete apparatus.]

If you have made any really new apparatus, photograph it and send us a description. It will pay you.

HOW TO REMEMBER OHM'S LAW.

Textbooks state that electromotive force (or volts) designated by the symbol *E*, divided by resistance (*R*) equals current in amperes (*I*); electromotive force divided by current gives the resistance, and resistance multiplied by current shows the electromotive force traversing a circuit. So simple, says R. M. Telschow, in *Telegraph and Telephone Age*, yet so elusive to all students. Science is built around exact formulas and processes, and you can scarcely hope to lay the foundation of a successful career by haphazard methods. So you start all over again, and deepen the furrows made in your fertile brain area by previous efforts.

It may be that the writer is a natural dullard, for these initial principles proved very elusive. Finally, however, the unwilling factors were successfully harnessed, and the trite word "Erie" proved the happy medium.

Henceforth $E \div R = I$, $E \div I = R$ and $R \times I = E$ was simply a matter of mentally looking at the magic word "ERIE." Reading it $E \div R = I$ gave me formula number one; backwards, $E \div I = R$; and forever unforgettable was the multiplication of the central letters *R* and *I* whose product was the *E* on either side of the multiplied factors. Thus, doubt departed forever with the introduction of the "Erie" short cut. Truly a case of "multum in parvo."

EXPERIMENTAL CHEMISTRY.

(Continued from page 110)

THE METRIC SYSTEM.

How the table is made up:

Divide a meter into ten equal parts. One of these parts is a DECIMETER.

If a decimeter is divided into ten equal parts, each one of these parts is one CENTIMETER.

If a centimeter is divided into ten equal parts, each one of these parts will represent one MILLIMETER.

Ten METERS make one DEKAMETER.

Ten DEKAMETERS make one HECTOMETER.

Ten HECTOMETERS make one KILOMETER.

Ten KILOMETERS make one MYRIAMETER.

TABLE

10 Millimeters	(m.m.)	(surface)	1 Centimeter	(c. m.)
10 Milligrams	(m. g.)	(weight)	1 Centigram	(c. g.)
10 Milliliters	(m. l.)	(liquid)	1 Centiliter	(c. l.)
10 Centimeters	(c. m.)		1 Decimeter	(d. m.)
10 Centigrams	(c. g.)		1 Decigram	(d. g.)
10 Centiliters	(c. l.)		1 Deciliter	(d. l.)
10 Decimeters	(d. m.)		1 Meter	(M)
10 Decigrams	(d. g.)		1 Gram	(G)
10 Deciliters	(d. l.)		1 Liter	(L)
10 Meters	(M)		1 Dekameter	(D.m.)
10 Grams	(G)		1 Dekagram	(D. g.)
10 Liters	(L)		1 Dekaliter	(D. l.)
10 Dekameters	(D.m.)		1 Hektometer	(H.m.)
10 Dekagrams	(D. g.)		1 Hektogram	(H. g.)
10 Dekaliters	(D. l.)		1 Hektoliter	(H. l.)
10 Hektometers	(H.m.)		1 Kilometer	(K.m.)
10 Hektograms	(H. g.)		1 Kilogram	(K. g.)
10 Hektoliters	(H. l.)		1 Kiloliter	(K. l.)
10 Kilometers	(K.m.)		1 Myriameter	(M.m.)
10 Kilograms	(K. g.)		1 Myriagram	(M. g.)
10 Kiloliters	(K. l.)		1 Myrialiter	(M. l.)

USEFUL METRIC TABLES

1 inch	equals	2.54 centimeters (Approx. 2.5 c.m.)
1 Centimeter	"	0.3937 inch (Approx. 0.4 inch)
1 liter	"	1,000 cubic centimeters
1 liter	"	0.2642 gallon
1 liter	"	1.057 quarts
1 pint	"	0.473 liter
1 quart	"	0.946 liter
1 fluid ounce	"	29.57 cubic centimeters
1 fluid dram	"	3.7 cubic centimeters

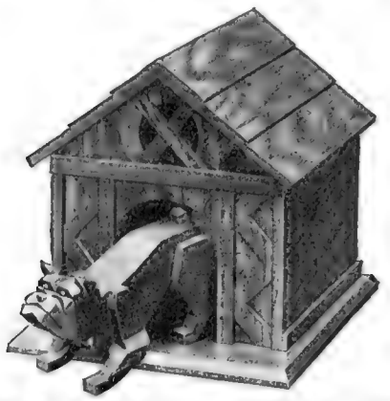
The gram is the unit of 1 cubic centimeter of water at 4 degrees Centigrade.

1 gram	equals	0.035 ounces (Avoirdupois)
1 gram	"	15.43 grains
1 ounce	"	28.35 grams
1 kilogram	"	1,000 grains
1 kilogram	"	2.2 pounds
1 Metric ton	"	1,000 kilograms
1 Metric ton	"	2,205 pounds

In our July issue Mr. Wilsdon will give us chemical definitions and he will show us how to perform simple chemical experiments.—Editor.

AN ELECTRIC PUP THAT HEEDS YOUR CALL.

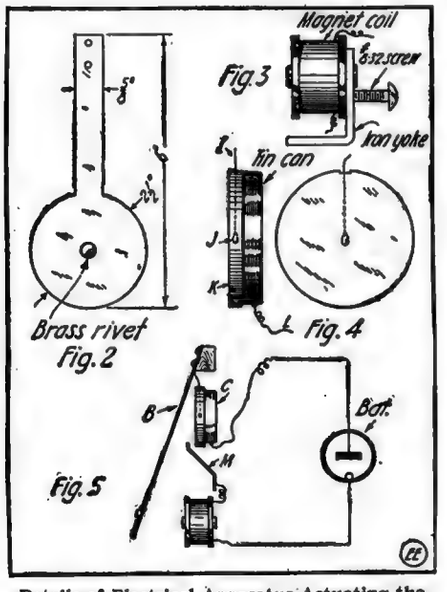
Here is an electric pup that will surely interest every electrical experimenter, not to mention his small brother or sister, as well as the rest of the family. All you have to do to call out his "reverence, the pup" from his kennel is to speak to him or blow a whistle. Electricity serves as the modus operandi. The pup himself is



This Electric "Pup" Comes Forth at Your Call.

about 4 to 5 inches long and about 3 inches high, being cut from wood on somewhat of a Cubist pattern. This wooden dog is made so as to slide along the floor of the kennel and out of the opening in the front of same.

The electrical apparatus operating this remarkable "hound" is perceived at A, B, C and D (Fig 1). A is a small electro-magnet about the size of an ordinary 75-ohm telephone receiver spool and wound full of No. 26 insulated copper magnet wire. This is secured to the back of the coop by means of a screw fitted into the iron yoke of same, as indicated more in detail at Fig. 3. A rather stiff iron or soft steel spring B is supported on the tapered wooden block D. The position of this spring when not held down by the electro-magnet A is shown at Fig. 5, and, as becomes evident, if released quickly so as to assume the



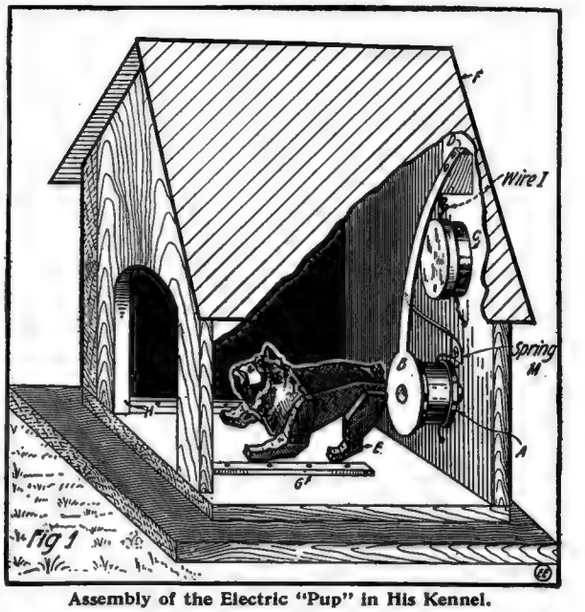
Details of Electrical Apparatus Actuating the Electric "Pup" Outfit.

position there depicted it will propel the pup forward and out of the kennel.

Below the block D is mounted a small tin can, such as those used for shoe polish. A hole is cut through the top to permit the entrance of a steel wire I. This wire does not touch the tin box C at the lower extremity J, Fig. 4, where a small graphite bob serves to hold it in very close proximity to the diaphragm K, which is at the same time the top of the box. A spring M helps to release the iron armature B. In the operation of the apparatus all of the parts must be adjusted carefully, so that the armature will just hold against the electro-magnet faces at A. A brass rivet mounted in the center of the disc B helps to render the magnet quick releasing.

A small flashlight battery placed within the miniature dog-house operates the device in good fashion. Its action depends upon the fact that when a certain whistled note or voice sound impinges against the diaphragm K of the tin box C it causes same to vibrate; in so doing it makes and breaks the electric circuit as outlined at Fig. 5. The slightest variation in the strength of the circuit causes the electro-magnet to release the spring B which must be reset by hand. The whole arrangement will now be thoroughly understood. It is best to have the diaphragm K tuned to some certain note and use a whistle or pitch pipe of this same note to call forth the pup from his domicile. In most cases clapping the hands once will bring him forth in a jiffy.

This "Wireless Pup" is now regularly manufactured by an Eastern manufacturer. A sample in possession of the editor works so well that the pup will jump from the kennel if a whistle is blown 15 feet away from the pup.



Assembly of the Electric "Pup" in His Kennel.

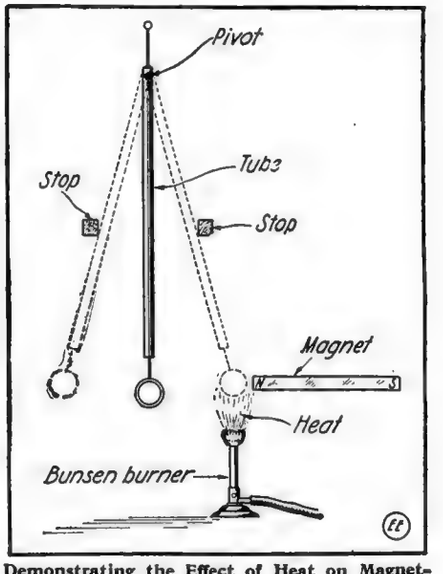
A SMALL LEAD STORAGE BATTERY.

A small lead storage battery can be made by putting two sheets of ordinary lead in a glass battery jar containing a dilute solution of sulphuric acid. To charge this battery connect the lead plates in series with an ammeter and a dry battery of four cells, giving about six volts pressure. While the current is passing, bubbles of gases will rise from each plate. After a few minutes, if the circuit is disconnected and the two wires attached to the lead plates are touched to a voltmeter, the meter will show a pressure of about two volts. If these wires are then connected in series with the ammeter and a small electric bell, the bell will ring, and the deflection of the ammeter needle will show the current to be passing in opposite direction to that used in charging the battery. When lifted out of the solution after charging the positive plate will be found to be colored brown, due to a coating of lead peroxide, while the negative plate will retain its usual gray color.

DEMONSTRATING EFFECT OF HEAT ON MAGNETISM.

A paper presented before the Société de Physique recently by M. Cotton cited the rapid disappearance of the magnetism of iron at a red heat, and he illustrated this action by an experiment in which the effect was readily seen. A long aluminum tube is arranged so as to swing freely from a pivot support at the top end, and means are provided to limit the swing by a stop piece. At the lower end of the tube is a curved platinum wire carrying a sheet-iron plate at one end. The device is placed near the poles of a strong magnet, so that the tube or pendulum swings toward the magnet, owing to the attraction exerted on the iron plate, and the pendulum is thus drawn to the limit of its swing. The flame of a large Bunsen burner, or other source of heat, is placed so as to entirely surround the iron plate when in this position, and when the latter reaches a red heat it loses its magnetic properties and ceases to be attracted, so that the pendulum now falls down to the zero position.

When the iron plate cools down it resumes its magnetic properties and is again attracted by the magnet, so that the plate enters the flame and becomes heated, and so on. In this way the pendulum is made to keep up a constant swing. On this principle the loss of magnetism by heat can be made the basis of a device which furnishes motive power, though in a small amount in the present case. It is an interesting experiment and upon such apparently non-important physical effects our whole electrical industry and science is based.



Demonstrating the Effect of Heat on Magnetized Iron.

An electric light is now made small enough to be attached to the ordinary dry battery cell. It will give a strong beam of light for several hours.

MAKING A MOVING COIL RELAY.

Many experimenters are in need of a very sensitive relay; one that is more responsive than the polarized type. The commercial instrument is beyond the means of

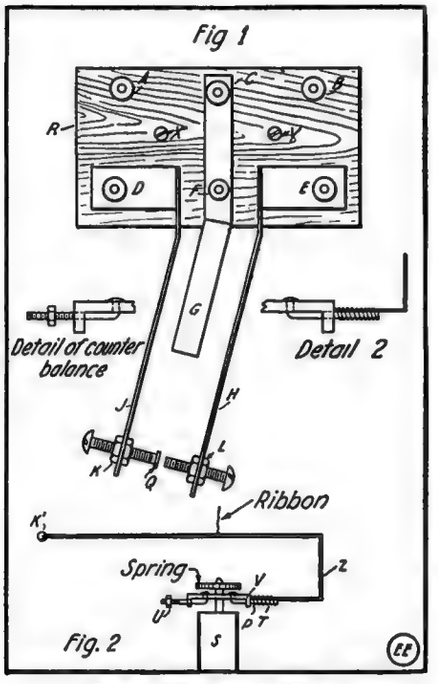
Sensitive Relay Constructed from Moving Coil Type Measuring Instrument.

the average experimenter, financially and mechanically.

Anyone having a moving coil type of Weston voltmeter or ammeter can make a very sensitive instrument. This instrument compares very favorably with high-resistance telephone receivers for detecting small currents.

The instrument shown in the picture gave a large deflection on .2 milliamperes. An old dry cell whose E.M.F. was about 1 volt (as it was polarized), operated the relay through more than 5,000 ohms resistance.

The case and scale should be removed from the meter and a suitable hardwood base prepared, with holes bored to correspond with the holes in the casting which supports the magnet and the moving coil.



Details of Moving Coil Relay.

The general make-up is shown in the photo and Fig. 1; R is the hard rubber or fiber base to support the contacts, about 2½ by 1½ inches and ⅛ inch thick. A and B are the binding posts for the line circuit. C and D are for the local circuit. Bolt E is to secure the stop arm H, and F is to secure the support G. The binding post D secures the contact arm J. The holes for the machine screws X and Y should be drilled to correspond with holes in the upright portion of the casting. The material for the arms J and H should be about No. 20 B. and S. gauge sheet brass. The angle at which the arms are bent is dependent upon the position of the moving arm at its neutral point.

At the extremities of the contact arm and stop, brass machine screws are placed. As it is difficult to thread the thin brass to fasten the screws to, the nuts K and L are soldered to the outside of the arms. The other two nuts are used to make the screws more secure. A silver or platinum contact point Q should be soldered to the screw as shown. The other arm does not need this, as it is only used as a stop for the moving contact arm.

The moving coil and arm are shown in Fig 2. The arm proper Z is made of No. 24 spring brass wire. The arm is bent to the shape illustrated to act as a balance. This is necessary in any place subject to vibration, etc., as on shipboard. If it is to be used in a quiet place the contact arm could be extended straight out at a right angle to the moving coil S and contacts thusly arranged. There are two methods of fastening the contact arm shown to the aluminum support V. Detail No. 2 is the least difficult. The aluminum needle was cut off as shown. The brass arm is then bound to it by fine thread and glued. In Fig. 2 the needle was removed and brass arm fitted into its place, but this is more difficult.

The upright G, Fig. 1, is to support a fine phosphor bronze ribbon, which may be obtained at an experimenters' supply house. Phosphor bronze is used as it is pliable and will not easily break. The ribbon is soldered to the arm G; the other end is soldered to the moving coil and in line with it. The ribbon is used to convey the current from the arm G to the contact arm Z. The silver or platinum contact K^1 should be soldered to the extremity of the arm on the side adjacent to the permanent contact Q. Both contacts should be filed parallel and made to line up nicely.

The counterweight U attached to the opposite end of the aluminum support V should be adjusted to balance the arm. The connections from the moving coil are taken from the screws which support the upper pivot bearing. The wires are then led to the line binding posts A and B.

The experimenter now has a very sensitive relay. If it is to be used for coherer work an auxiliary resistance will be necessary in order to reduce the current through the instrument, as it is necessary to use only a small current in this case. The instrument should be mounted on a large base and covered with some form of a case to keep out dust and dampness.

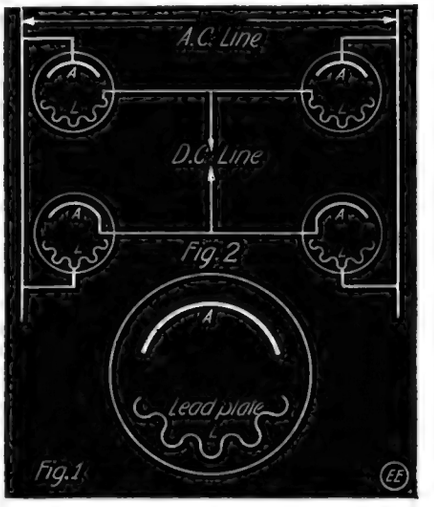
Contributed by R. S. RYBERG.

HOW TO MAKE AN ELECTROLYTIC RECTIFIER.

Many devices which will change alternating to direct current have been put on the market, but probably none of them suits the amateur as well as this one.

For the construction of such an instrument four two-quart fruit jars with two electrodes, one of lead and one of aluminum, for each jar are required. Place the electrodes in the jar, the immersed surface of the aluminum being about one-half that of the lead. To accomplish this, the lead plate should be crimped as in Fig. 1. In each illustration the lead is indicated as L and the aluminum as A. The solution consists of:

Water, two quarts; sodium bicarbonate,



Improved Design for Electrolytic Rectifier.

two tablespoonfuls; alum, three tablespoonfuls.

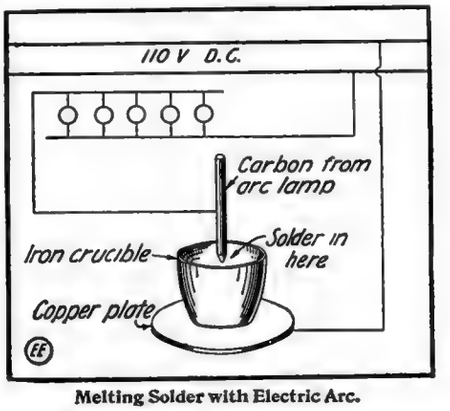
Make the connections as shown in Fig. 2. The alternating current comes in on the wires as indicated and the direct current is taken from the point shown in Fig. 2.

The capacity of this rectifier is from three to five amperes, which is sufficient for charging storage batteries, running a motor or lighting small lamps.

Contributed by ALEXANDER V. BOLLERER.

USING AN ARC TO MELT SOLDER.

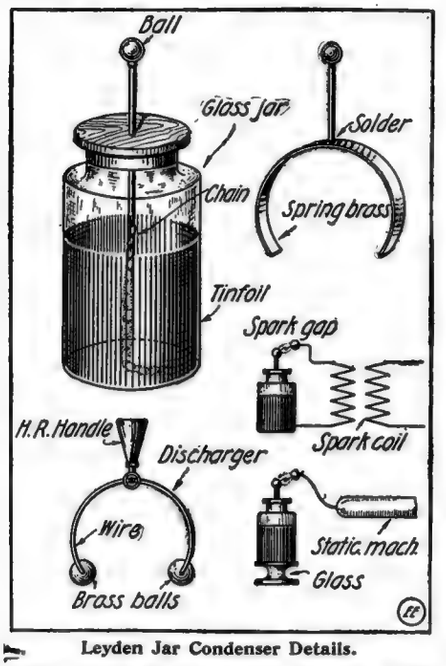
The electric arc, which is capable of producing the most intense heat of any device known to science, practically speaking, can be utilized very nicely for many every-day requirements, as, for instance, in the melting of solder. The solder is placed in an iron crucible resting upon a copper plate. An arc lamp carbon is used for the upper electrode with which to draw the arc from the solder. In series with this arrangement, there is placed a bank of lamps of the same rating as that of the circuit supplying the current. A water rheostat or other resistance may be used in place of the lamp bank if desired, says a writer in the *Electrical Review and Western Electrician*. After the arc is once struck the carbon electrode is held a short distance from the solder. The heat is so intense that it will melt it in a very short time.



Melting Solder with Electric Arc.

LEYDEN JARS.

In the year 1745 Von Kleist tried to collect electricity in a bottle of water by passing the current from his static machine down through a nail thrust through the cork of the bottle. He was indeed surprised when he found that he had really collected electricity in a bottle. This was the first Leyden jar, and from that time it has been improved greatly. Below are enumerated the qualities necessary in a good Leyden jar and the bad qualities in some poorly constructed jars.



Leyden Jar Condenser Details.

The first consideration is the glass. It should be in the form of a wide-mouth jar to permit the inside coating of foil to be easily applied. The jar should be the best, hard, thin, Bohemian glass, free from lead, of uniform thickness, and also free from air bubbles and imperfections. The thinner the glass the greater the capacity, but the easier to puncture if overcharged. Glass showing a tinge of red color should be avoided, but glass with a *faint* greenish color makes excellent Leyden jars. When the jar is perfectly dry and cold, and is briskly rubbed with a silk handkerchief it should then produce a distinct spark when presented to your finger. Jars that hold this kind of electrification longest are most desirable. Last of all, the glass jar should ring clear and true when snapped with the finger.

Although many adhesives are used to hold the tinfoil to the glass, perhaps the best of all is banana oil, which is used in many gold paints. Shellac and thin glue may also be used. The higher the foil reaches toward the top of the jar the greater the capacity, and for wireless work the foil may extend quite near to the top. However, the less the height of the foil the longer it will hold the charge. When they are used in connection with a static machine the best height for the foil is about one-half the height of the jar. Foil should be put on the inside first, as it is then easier to see how smooth you are applying it. It is a good plan to coat the upper edge of the foil, both inside and out, with a good coat of thin shellac to prevent brush discharge.

The one place where a great many amateurs lose efficiency is in the cover for the jar. This had best be made of hard rubber or fibre, although very dry wood, heated well in an oven, and boiled in melted paraffin, is very satisfactory. The design of the cover must be left to the ingenuity of the individual, as it differs widely with different kinds of jars.

The brass rod which goes through the cover terminates on the inside with a chain and on the outside, in a brass ball (solid or hollow). The rod and ball should be perfectly smooth and polished to prevent the charge escaping from protruding points, as is its tendency.

Many amateurs do not know how to charge a Leyden jar with a spark coil, so that the jar will retain the charge. In order to do this one high-tension terminal of the spark coil must be directly connected to the outside coating of the Leyden jar and sparks allowed to pass between the other high-tension terminal of the spark coil to the ball terminal of the jar. If the sparks pass in a steady stream, make the gap a little longer until the sparks do not pass very steadily. A little experimenting will show the correct distance to obtain the best results. The best and safest way to discharge a Leyden jar is by means of a discharger in the form of a wire loop having ball terminals.

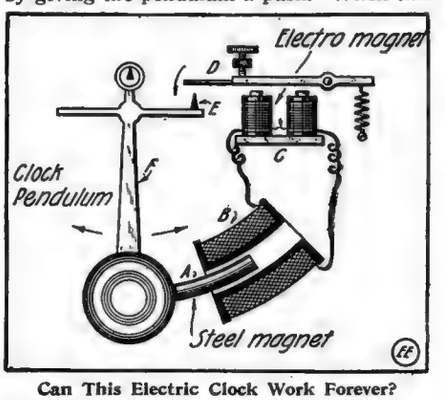
To charge a Leyden jar to full capacity by a static machine place the jar on an insulated base. Let the knob of the jar be close enough to the prime conductor of the static machine to allow sparks to pass. After working the static machine for a time the sparks stop. Now present your finger to the outside of the jar and sparks will pass between your finger and the jar and at the same time more sparks will pass between the prime conductor of the static machine and the knob of the jar. In a short time no more sparks will pass either between your finger and the outer coating of the jar or between the knob and the prime conductor of the static machine. The Leyden jar is now fully charged and should be handled cautiously, as the discharge from a large, fully charged jar taken through the body is not only very unpleasant, but is often painful and dangerous.

Contributed by D. J. THOMSON.

SOLVE THIS ELECTRICAL "PERPETUAL MOTION" PROBLEM AND WIN A PRIZE.

To those sending in the most concise and accurate statement as to why the electrically operated clock described herewith will or will not operate perpetually, we will give one year's subscription free to *The Electrical Experimenter* magazine.

The proposed electric clock has a regular swinging pendulum F, carrying a cross arm or projection E, at its upper extremity and at its lower end a permanent steel magnet A. Now suppose the clock is started by giving the pendulum a push. When this action takes place, the magnet moving through the hollow core of the solenoid or magnet winding B, produces a current therein and this current acts upon two electro-magnets C. The moment they are energized in this way they attract an iron armature D, which in its downward travel strikes the projection E attached to the pendulum rod, thus causing the pendulum to swing backward and repeat the operation. Apparently this device will keep on working to the end of time, the only difficulty being that it don't! Why not?

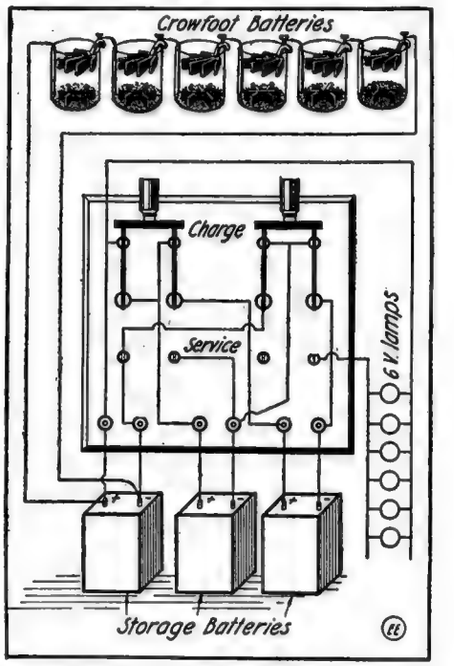


Can This Electric Clock Work Forever?

To facilitate our handling the replies, we request that the answers to this problem be stated in "fifty words or less." All communications should be addressed to the Editor, *The Electrical Experimenter* magazine, "Clock Contest." All replies should reach us not later than the thirtieth of this month.

USING GRAVITY BATTERIES TO CHARGE STORAGE CELLS.

A convenient method of charging storage cells with gravity batteries is outlined in the illustration herewith. A change-over switch-board is shown, connecting to both sets of batteries, so that when the two switches are in one position, say "charge," the crow-foot cells will re-energize the storage batteries. When the switches are thrown in the position marked "service," the storage cells are connected in series to the lamp circuit as perceived. The storage cell connected across the charging mains should be transposed with the other cells periodically, as it will tend to charge faster than the others and also it will not discharge as fast as the rest, in view of the fact that the crow-foot cells are "floated" across the terminals of same. The gravity cells yield about .95 volt each and for each storage cell under charge, the potential developed by the source of energy used to replenish same should be figured at 2.75 to 3 volts. In this case the storage cells are connected in parallel while charging, so that three or four gravity cells in series will usually suffice.



Scheme Utilizing Gravity Cells to Charge Storage Battery.

Contributed by V. A. SCHYE.

Dr. Alexander Graham Bell, inventor of the telephone and one of the pioneer experimenters in aeronautics, has asked the Aero Club of America to urge Congress to establish postal air routes, in accordance with the plans recently outlined by the Post Office Department.

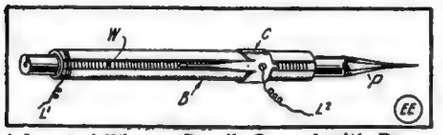
HOW TO MAKE IT

This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00

SIMPLEST VARIABLE POCKET RHEOSTAT.

Use a slim lead pencil and wind it with two strands laid together, one of these being of fine resistance wire W and the other thread. Over this roll a strip of cardboard B, so as to leave a narrow strip exposed along one side. Bind the ends



A Layer of Wire on Pencil, Covered with Paper Together with the "Clip" Provides a Handy Rheostat.

of this and use a pen clip C, with a light spring for a slider. One lead should be soldered to the clip and the other is taken off at the beginning of the winding. Quite a wide range of resistance may be obtained from this instrument.

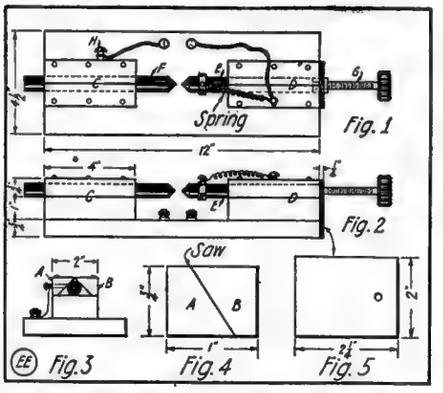
Contributed by ORVILLE HUISH.

EXPERIMENTAL ARC LAMP.

I give herewith details for making a simple hand feed arc lamp.

Fig. 1 shows a top view of the arc lamp, which, I think, requires no explanation. Figs. 3 and 4 show the pieces that hold the carbons (marked A and B). If a piece of wood 8 inches long, 1 inch wide and ¾ inch thick is marked off on the end as shown in Fig. 4, and is sawed at that angle, through the whole length, then if piece A is inverted, it will form the shape shown in Fig. 3, if the two pieces are nailed on a block 2x1x8. That will make a piece 1¾x2x8, which must be cut in half on the 4 inch mark, to make blocks C and D, each one holding a carbon as perceived.

A spring is used to pull carbon E away from carbon F. Adjusting screw G enables the arc to be altered in length as desired. The spring is also used to make connection with carbon E. A woodscrew H is used to connect carbon F and also to hold it firmly in place.



Useful Experimental Arc Lamp Made Mostly of Wood.

With an asbestos lined box placed over the lamp and an adjustable lens, the writer has shown slides and a spotlight over a block away. It may be put to many other uses of course. The box is best made of sheet iron and the base of slate or soapstone. Blocks C and D are well made of brass for a good job.

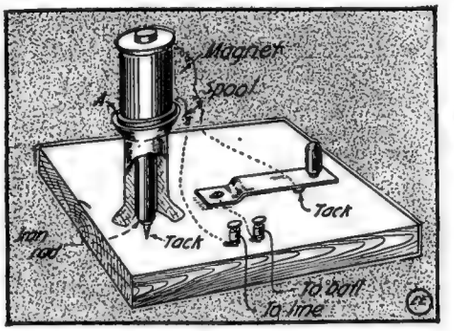
Contributed by LEONARD MABBOTT.

SECOND PRIZE $2.00

LOW-PRICED TELEGRAPH SET.

A common thread spool is nailed on a board and a piece of iron rod a little shorter than the spool itself should be procured to fit loosely within it. The rod should drop on a tack. An old bell magnet should be glued to the spool at A. The illustration clearly shows the strap key and connections. The manner in which this set works will surprise you.

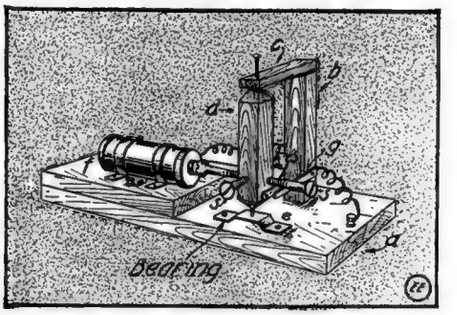
Contributed by PAUL KENNEDY.



Electro-Magnet Attracts Iron Rod within Spool. A Simple Telegraph Sounder.

NOVEL ELECTRIC ENGINE.

Herewith is a description of a Novel Electric Engine which can be constructed from a single electro-magnet, together with a wooden armature, in which are placed four iron machine or wood screws. The Electro-magnet f is strapped fast to the



The Simplest Electric Motor. Utilizes One Electro-Magnet, a Wooden Armature Fitted with Iron Screw Poles and a Pair of Brushes.

wooden base, and the armature d is supported in a foot step bearing e, and at the top by means of a nail driven in the end of the shaft, as in the drawing. The electrical circuit includes the electro-magnet, also the armature d, with a pair of spring metal brushes g in series with it. The battery is connected to a pair of binding posts mounted on the base of the engine.

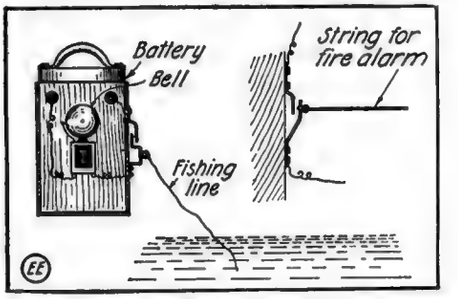
The brushes can be made of brass, copper or any metal that is quite thin and not too limber. The brushes, which need not be very wide, are placed as shown at g. The engine is now complete. The main part, after making the connections, is to have the brushes adjusted just right. Any mechanic can see without further explanation how it works. The illustration shows the adjustment of the brushes. This engine, when made correctly, will run at a high rate of speed.

Contributed by HARRY OSTNESS.

THIRD PRIZE $1.00

ELECTRIC SIGNAL FOR FISHERMEN.

On a cold, wet day fishing is liable to be a disagreeable task, and the following plan will prove of interest undoubtedly. An



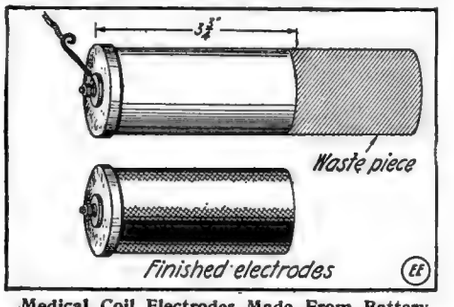
When a Fish "Bites" the Pull on the String Closes an Electric Bell Circuit.

electric bell is mounted on a box containing a flashlight battery connected to a spring switch or circuit maker. The illustration shows quite clearly how it is made. This same method may be used in a barn or house as a fire alarm if the string is kept normally taut, as shown. When the hay loft burns, for instance, the string will break, releasing the switch spring.

Contributed by HARRY RILEY.

HAND ELECTRODE FOR MEDICAL COILS.

Procure two flat-top battery carbons and boil them for several minutes to remove incrusted salts, paraffine, etc. Measure off 3¾ inches, or any convenient length, and file a deep groove all around. Then strike sharply with a hammer on the waste piece



Medical Coil Electrodes Made From Battery Carbons.

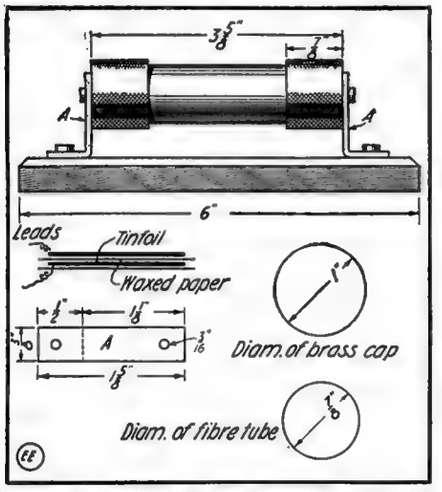
side of the groove until the carbon breaks at this mark. File the rough end until smooth and the electrode is finished.

Contributed by N. ROHACS.

FIXED CONDENSER IN FUSE CARTRIDGE.

A neat and effective fixed condenser can be made out of a blown 125-ampere cartridge fuse. Take off one of the brass caps and cut off the tube so that it will be 3½ inches long. Now take two strips of brass, A, 1⅝ inches long by ⅜ inch wide, and bend according to drawing. Then bore two 3/16 inch holes in each end.

The condenser may comprise two pieces of tinfoil 44 inches long and 2½ inches wide, also two pieces of waxed paraffined paper 46 inches long and 3 inches wide. Place the tinfoil as in drawing, roll tightly and when almost at the end place two



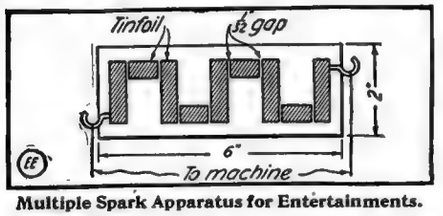
Compact Fixed Condenser in Cartridge Fuse Shell.

wires about three inches apart, under the tinfoil and waxed paper. Place it in the fiber tube, solder the wires to the caps, and put together. Any size piece of wood will serve as a base, but the one about 6 inches by 2½ inches is best.

Contributed by A. W. O. LARSON.

A NOVEL SPARKING EFFECT.

The following apparatus can be very quickly and easily constructed, and the results obtained will fully repay the two or three minutes set aside to do so. All that is needed is a piece of stiff cardboard, a little tinfoil and paste. Cut the tinfoil into rectangular strips and paste them end to end on the cardboard, as shown in the illustration, leaving a very small air gap between them. Now arrange some kind of



Multiple Spark Apparatus for Entertainments.

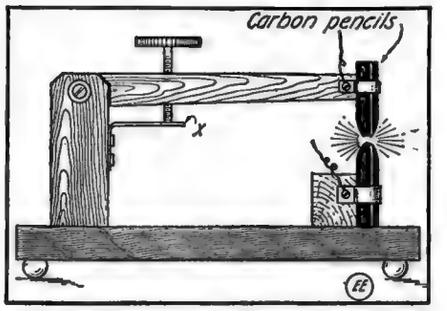
hook on both ends, as shown, and attach it to a static machine or spark coil. When in action numerous sparks will be seen to pass between the air gaps, producing a very pleasing effect in the dark. It is clear that the tinfoil can be cut so as to form different designs if desired, such as letters in script, etc., providing the air spaces between them are not too great. A 1/32 inch gap is sufficient usually.

Contributed by JAS. GERSCHLER.

Make your wireless station comply with the Underwriters' rules; it will pay in the end.

NOVEL HAND FEED ARC LAMP FOR AMATEURS.

Herewith is described an unusually simple yet efficient electric arc light for use during brief periods of photography where a substantial illumination is required.



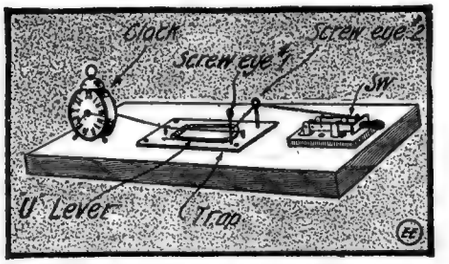
Arc Lamp of Simple Construction.

Using the short lengths of carbons discarded by moving picture operators, there is no difficulty in maintaining a brilliant arc for several minutes without once manipulating the adjusting screw at the top. Only three pieces of wood (slate is better) are necessary, and in the preparation of these no particular care need be exercised except to have the top arm swing freely up and down, and without any appreciable side movement. The carbon holders are merely strips of heavy tin, which need only be screwed up sufficiently tight to hold the carbon sticks. The illustration explains everything, and a sort of arm made from thick tin or brass (X), bent at 90 degrees, will assist the adjustment of the carbon by the long, slender wood screw threaded in the wood bar, as perceived. This thumb-screw is easily operated and a very minute adjustment of the carbons affected to about 1-32 of an inch accuracy. In operating any arc light on the commercial 110-volt current some ballast resistance must be placed in the circuit. An earthen jar filled with water, with two strips of tin or lead for electrodes, will answer this purpose. It is a valuable addition to any photographic laboratory.

Contributed by WM. WARNECKE, JR.

TIME SWITCH.

An ordinary 10-cent spring mouse trap is all that is required outside of the usual switch (D. P. S. T. type), and an alarm clock. Mount them on a base in the order shown. Two screw eyes are put in, one on a pillar (2) and one put lower at 1. A string is attached to the winding key of the clock and to the mouse trap trigger. At the "set time" the trigger will trip and the "U" lever will fly over. If the switch is to be opened a string is run from the "U" lever, through screw eye 2 and to the switch handle. If it is desired to close



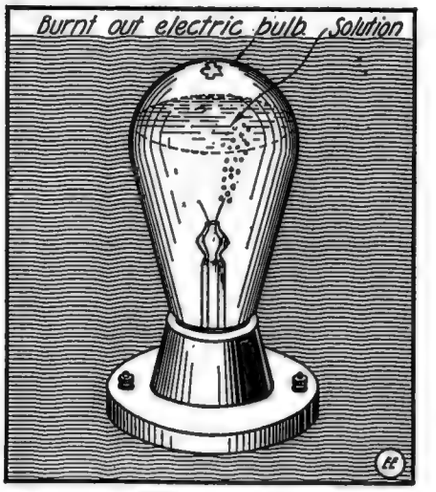
Time Switch Made from Ten Cent Mouse Trap, Alarm Clock and Switch.

the switch run the string through the lower screw eye. Another use to which the mouse trap may be put is to open and close the shutter of a camera. Then a string is run from the clapper of an electric bell to the trigger and also a string to the shutter from the "U" lever. Set the bell to ring for an instant and the trigger will be disturbed. The gong should be removed from the bell.

Contributed by I. ROSIN.

POLARITY INDICATOR MADE FROM AN OLD ELECTRIC LIGHT BULB.

Perhaps some of the readers of *The Electrical Experimenter* need a polarity indicator, but find the battery type more or less clumsy. The writer made one from a burned-out incandescent light bulb. First knock off the glass tip, leaving a small hole, through which a fine wire is inserted to break off the filaments, leaving the two larger wires, as illustration shows. Next make a solution of salt water, which is poured into the bulb through the hole by means of a small funnel. By screwing this into a socket and switching on the current



Polarity Indicator Made From Lamp Bulb Filled with Salt Water.

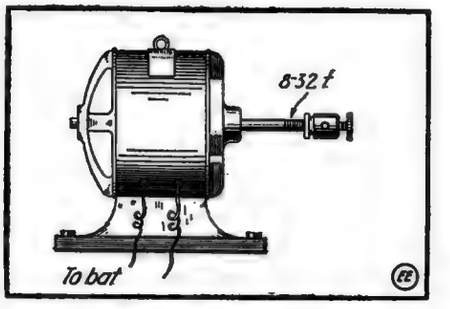
the negative pole can be ascertained by the bubbles which rise from it.

(By breaking off the tip of the lamp, under the solution of salt water, by means of a pair of pliers the bulb will fill itself.—*Editor.*)

Contributed by AN EXPERIMENTER.

HOME-MADE POLISHER FOR BINDING POSTS.

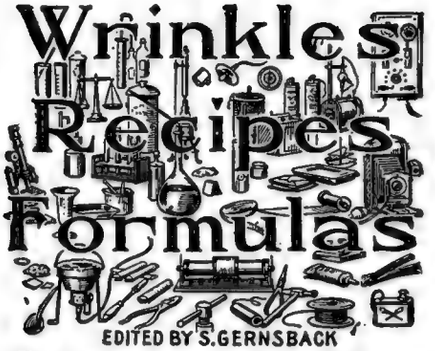
After fastening the binding post to the motor shaft according to the accompanying illustration a piece of sandpaper or emery cloth is held against the post until all dirt and rust is cleaned off; then some metal polish on a rag is held against it, with the



Binding Post Polisher.

final polish being made by using a dry cloth.

Contributed by FRANCIS R. PRAY.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 22.
Bronzing Compositions.

Silver White Bronzing Powder.—Melt together 1 oz. each, bismuth and tin, then add 1 oz. quicksilver, cool and powder.

Gold Colored Bronze Powder.—Verdigris, 8 ozs.; putty powder, 4 ozs.; borax and nitrate, of each 2 ozs.; bichloride of mercury, ½ oz.; make into a paste with oil and fuse them together. Used in japanning as a gold color.

Beautiful Red Bronze Powder.—Sulphate of copper, 100 parts; carbonate of soda, 60 parts; apply heat until they unite into a mass.

Antique Bronze Paint.—Sal ammoniac, 1 oz.; cream of tartar, 3 ozs.; common salt, 6 ozs.; dissolve in 1 pt. hot water; then add nitrate of copper, 2 ozs.; dissolve in ½ pt. of water; mix well and apply it to the article in a damp place with a brush.

Blue Bronze on Copper.—Clean and polish well, then cover the surface with a fluid obtained by dissolving vermillion in a warm solution of sodium, to which some caustic potash has been added.

Bronze Dip.—Sal ammoniac, 1 oz.; salt of sorrel (binoxolate of potash), ¼ oz.; dissolved in vinegar.

Parisian Bronze Dip.—Sal ammoniac, ½ oz.; common salt, ½ oz.; spirits of hartshorn, 1 oz.; dissolved in an English qt. of vinegar. A good result will be obtained by adding ½ oz. sal ammoniac instead of spts. of hartshorn; the piece of metal when well cleaned is to be rubbed with one of these solutions, then dried by friction with a fresh brush.

Green Dip.—Wine vinegar, 2 qts.; verdigris, 2 ozs.; sal ammoniac, 1 oz.; salt, 2 ozs.; alum, ½ oz.; French berries, 8 ozs.; boil the ingredients together.

Aquafortis Dip.—Nitric acid, 8 ozs.; muriatic acid, 1 qt.; sal ammoniac, 2 ozs.; alum, 1 oz.; salt, 2 ozs.

Olive Bronze Dip for Brass.—Nitric acid, 3 ozs.; muriatic acid, 2 ozs.; add titanium or palladium, when the metal is dissolved add 2 gals. pure soft water to each pt. of the solution.

Brown Bronze Paint for Copper Vessels.—Tinct. of steel, 4 ozs.; spts. of nitre, 4 ozs.; blue vitriol, 1 oz.; water, ½ pt.; mix in a bottle, apply it with a fine brush, the vessel being full of boiling water. Varnish after the application of the bronze.

Bronze for All Kinds of Metal.—Muriate of ammonia (sal ammoniac), 3 drs.; oxalic acid, 1 dr.; vinegar, 1 pt.; dissolve the oxalic acid first; let the work be clean, put on the bronze with a brush, repeating the operation as many times as may be necessary.

Green Bronze.—Dissolve 2 ozs. nitrate of iron, and 2 ozs. hyposulphate of soda in 1 pt. of water; immerse the article until the required shade is obtained, as almost any shade from brown to red can be obtained according to the time of immersion, then wash well with water, dry and brush.

Pale Deep Olive Green Bronze.—Perchloride of iron, 1 part; water, 2 parts. Mix and immerse the brass.

Dark Green.—Saturate nitric acid with copper and immerse the brass.

Dead Black for Brass Work.—Rub the surface first with tripoli, then wash it with a solution of 1 part, neutral nitrate of tin, with 2 parts, chloride of gold, after 10 minutes wipe it off with a wet cloth.

Best Bronze for Brass.—Take 1 lb. of nitric acid, and ½ lb. of white arsenic, put them into an earthen vessel and then proceed in the usual manner.

Another Bronze for Brass.—1 oz. muriate of ammonia, ½ oz. alum, ¼ oz. arsenic, dissolve together in 1 pt. of strong vinegar.

Black Dip for Brass.—Hydrochloric acid (commonly called smoking salts), 12 lbs.; sulphate of iron, 1 lb.; and pure white arsenic, 1 lb. This dip is used in all the large factories in Birmingham, but the dip used in the London trade is 2 ozs. corrosive sublimate, in 1 pt. of the best vinegar, cork both in an air-tight bottle, let it stand 24 hours; then it is fit for use.

Quick Bright Dip for Brass.—Use strong nitric acid in sufficient quantity, dip your brass in the liquid for an instant, withdraw, and immediately immerse it first in cold water, and then in boiling water, for a short time only in each bath, then allow it to dry; repeat the process if necessary.

Application of Bronze Powder.—The proper way is to varnish the article and then dust the bronze powder over it after the varnish is partly dry.

Black Color for Brass Work.—Make a strong solution of nitrate of silver, and nitrate of copper separately. Mix the two together and plunge in the brass. Now heat the brass evenly till the required degree of blackness is acquired. Unrivalled as a beautiful color on optical instruments.

VALUABLE HINTS FOR THE AMATEUR.

Bronzing Fluid.—(For brown). Iron filings or scales, 1 pound, arsenic 2 ounces, hydrochloric acid, 1 pound; metallic zinc, 1 ounce. The article to be bronzed is dipped in this solution till the desired effect is produced.

Sealing Wax.—(Red). Take 4 pounds shellac, 1½ pounds turpentine, 3 pounds finest cinnabar and add 4 ounces Venetian red. Mix the whole well together and melt over a very slow fire. Pour it on a thick smooth sheet of glass or any other flat surface and make it into sticks.

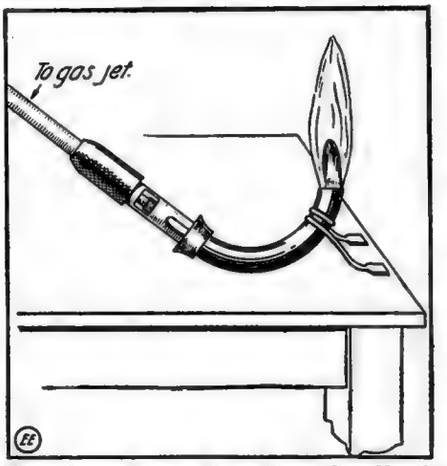
(Black). Take the best black resin, 3 pounds; beeswax, ½ a pound and finely powdered ivory black, 1 pound. Melt the whole together over a slow fire and mould into sticks.

Waterproof Compound.—Suet, 8 ounces; linseed oil, 8 ounces; neatsfoot oil, 1½ ounces; lampblack, 1 ounce; litharge, ½ ounce. Melt together and stir till cold.

Contributed by H. G. FRANK.

BUNSEN BURNER.

Recently I was in need of a Bunsen burner, and, not having one, hunted about for something to take its place. I found an old gas burner, the kind that is used with a mantle, and which can be purchased for a few cents. It was bent in the shape depicted in the illustration. By wrapping some heavy wire around the tube it can



Cheap Bunsen Burner Made From Gas Mantle Parts and a Piece of Wire.

be made to stand in an upright position. This burner will take the place of those costing 50 cents or more.

Contributed by P. M. RAMSEY.

SOLDERING FLUXES AND INSULATING VARNISH.

AN EXCELLENT SOLDERING FLUX.

This may be made by saturating a solution of zinc chloride in water and adding by weight one-tenth part of ammonium chloride. It is claimed that with this flux it is possible to solder enamel ware. This is impossible with most other fluxes.

A GOOD FLUX FOR SOLDERING TINFOIL.

This flux can be made by mixing sal-ammoniac (ammonium chloride) with vaseline and paraffine so as to form a paste. When soldering tinfoil it is advisable to lay the tinfoil on a sheet of copper, which conducts the heat away from the tinfoil. Otherwise the foil would be likely to melt.

INSULATING VARNISH.

White shellac 4 ounces, black amiline dye 1 tablespoonful. The aniline dye must be soluble in alcohol only. This mixture, if correctly made, when laid on with a soft brush will produce a shiny black surface, giving the instrument a neat appearance. It must be laid on quickly, as it sets in a few seconds.

Contributed by CARLISLE SHANNON.

SOME INTERESTING CHEMICAL EXPERIMENTS.

Fire-Proofing Cloth.—First get two glass tumblers. Add two teaspoonfuls of ammonium chloride to the water in the glass and stir until dissolved. In the other glass put a piece of cotton cloth two or three inches square and then pour the dissolved ammonium chloride into the glass containing the cloth and see that it is well soaked with the solution. Hang the cloth up and let it dry. Then touch it with a lighted match. It will burn in the flame, but will go out as soon as the flame is removed.

To Make Gun Powder.—Mix one teaspoonful of potassium nitrate, one-half teaspoonful of sulphur and one-half teaspoonful of powdered charcoal on a sheet of paper. This must be thoroughly mixed to make a good powder.

Sympathetic Ink.—With a clean steel pen write on white paper with a cobalt chloride solution and let dry. When the paper is held near a fire the writing will gradually appear, and disappear again when it cools, because the chloride absorbs moisture from the air. Even though the paper is scorched the writing will still be visible.

Green Alcohol Light.—Dissolve one-half teaspoonful boric acid in two and one-half teaspoonfuls of alcohol and light it. The flame will be bright green.

To Remove Marks Due to Match Scratches.—Rub the scratched surface with lemon and then wash with a clean rag dipped in water.

Contributed by RICHARD GAILLARD.

Experimental Chemistry

By Albert W. Wilsdon

ELECTRICITY and Chemistry are so closely related to each other that the study of one without the other tends to make the student and the experimenter very one-sided indeed. We might state that there can be no first-class electrician who has not a fair knowledge of chemistry. Great electricians such as Volta, Faraday, Ampère, Planté, Edison and countless others were all good chemists.

That is the reason for beginning our "Experimental Chemistry" in this issue. Chemistry is such an interesting study that we feel certain that all experimenters will welcome every installment. The course will extend over one year and as its name proclaims, it will be strictly experimental. The able author, Mr. Wilsdon will not feed us with formulas and theories—there are text-books for this purpose—but he will show us how to perform chemical experiments, using simple, non-technical language. We have every reason to believe that you will like the new department. EDITOR.

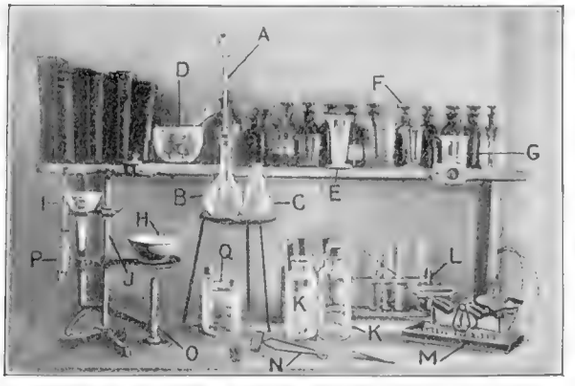
Apparatus.

MOST prospective students in chemistry are of the belief that a very elaborate and expensive laboratory equipment is necessary, but the purpose of this article, besides giving the elementary principles of chemistry, is to afford the average amateur with instructions for equipping a laboratory on an economical basis.

If the reader can afford it, I would advise that a set of glass stoppered reagent bottles be purchased. If these bottles are bought, obtain them with the name of the reagent and symbol blown in the glass, if possible.

List of Apparatus.

Two pieces asbestos, 4x4 inches; 1 balance scale with metric weights; 1 jeweller's blowpipe; 1 test tube brush; 1 Bunsen burner; 1 test tube clamp for test tubes, etc.; 1 porcelain crucible, No. 00 with lid; 1 evaporating dish, No. 0; 1 round file; 1 triangular file; 1 pair iron forceps, 4 inches; 1 piece iron gauze, 5x5 inches; 1 glass cutter; 1 mortar and pestle,



A—Thistle Tube. B—Florence Flask. C—Erlenmeyer Flask. D—Mortar and Pestle. E—Graduate. F—Reagent Bottles. G—Beaker. H—Evaporating Dish. I—Funnel. J—Ring Stand. K—8 ounce Bottles. L—Test Tube Rack and Tubes. M—Balance Scales. N—Test Tube Holder. O—Bunsen Burner. P—Test Tube Brush. Q—Wolff Bottle.

1 package filter paper, 4 inches; 1 test tube rack to hold 12 test tubes; 1 combustion spoon; 1 ring stand with 3 rings; rubber stoppers, assorted sizes, Nos. 0 to 5, one and two hole; 1 tripod, iron; 1 pipe stem triangle; glass tubing; 1 foot rubber tubing to fit glass tubing snug; 2 beakers, 100 c.c.; 1 beaker, 250 c.c.; 4 eight-ounce bottles; 2 two-hole stoppers and 1 one-hole stopper to fit above; 2 Florence or Erlenmeyer flasks; 1 Metric graduate, 25 c.c.; 4 glass plates, 4x4 inches; 6 or 12 test tubes, 6x¾ inches; 1 Thistle tube; 1 glass funnel.

The above apparatus can be purchased as required.

Laboratory Operations.

When measuring liquids, always read from the lower meniscus, as shown in the illustration.

If you spill any powder or liquid on the work table, wipe it up as soon as possible. Do not let it remain on the table for any considerable length of time without wiping it up.

When mixing Sulphuric Acid, ALWAYS REMEMBER that the water must NEVER be added to the acid. The correct way to mix this acid is to pour the water into a vessel, and add the acid, in small quantities, while keeping the liquid in constant movement by stirring.

When pouring a liquid into a test tube, extend the arms as far as possible and keep the middle of the tube on a level with your eyes. Never hold the tube close to your body, with your face over the tube, while pouring in a liquid.

Always do exactly as the experiment tells you. If the experiment calls for 5 grams, use 5 grams, otherwise you will not obtain the desired results.

Wash your test tubes and bottles after each experiment. Do not leave them for any length of time, as they will be much harder to clean.

Concentrated Acid means acid of the indicated specific gravity. Hydrochloric acid has a specific gravity of 1:19; Nitric acid has a specific gravity of 1:42, and Sulphuric acid of 1:84. Concentrated Ammonia should have a specific gravity of 0.09.

Diluted Acids (and Ammonium Hydroxide):—

Dilute 1 part of Ammonium Hydroxide with 4 parts of Water.

Dilute 1 part of Hydrochloric Acid with 4 parts of Water.

Dilute 1 part of Sulphuric Acid with 6 parts of Water.

Dilute 1 part of Nitric Acid with 4 parts of water.

The Metric system is the general unit of weights and measures in chemistry and all the experiments will call for the Metric weights.

Glass Working.

CUTTING GLASS PLATES:—

Lay the plate of glass on a perfectly smooth surface, and measure off the required distance from the edge of the plate. Now place a ruler on the plate in a line with the part to be cut, and with the left hand hold it in place. Take the glass cutter in the right hand and draw it over the glass (guided by the ruler), using a little pressure, and until you hear a distinct scratching noise. Now pick up the glass and with the side having the scratch away from you press gently outward with the thumbs and inward with the fingers. This should leave a fairly smooth edge.

BREAKING GLASS TUBING:—

Make a sharp scratch on the desired part of the tube with a triangular file. Make ONE SCRATCH, do not saw back and forth. Fig. 2 shows the method of accomplishing this.

FIRE POLISHING:—

After you break a piece of glass tubing hold it in the flame of a Bunsen Burner until the ends of the glass just begin to soften.

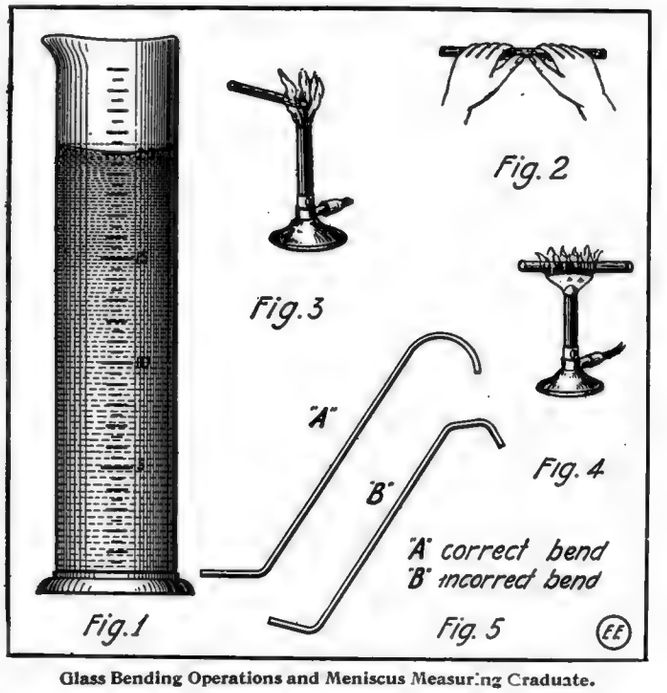
Fig. 3 shows the method.

BENDING GLASS TUBING:—

Use a "fish-tail" burner, which gives it a broad flat flame (Fig. 4). Hold the tube lengthwise in the flame so that the full heat of the burner will be centered on about two inches of the tube. Roll the tube between the fingers, so that the heat will be evenly distributed, but do not bend it or allow it to bend, while it is in the flame. The first indications that the tube is softening will appear when the flame turns to a yellow color. As soon as the heated portion of the tube is soft TAKE IT FROM THE FLAME and bend it at the angle which you desire. Do not put it on anything except the asbestos pad while it is hot. All bends should have the same diameter at the bend as at any other part of the tube.

In fitting a glass tube to a rubber stopper, ALWAYS run some water in the hole and wet the tube before inserting, otherwise the tube might break and cause serious results. A little common sense and care are prime requisites to good results.

(*Continued on page 103*)



Glass Bending Operations and Meniscus Measuring Graduate.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

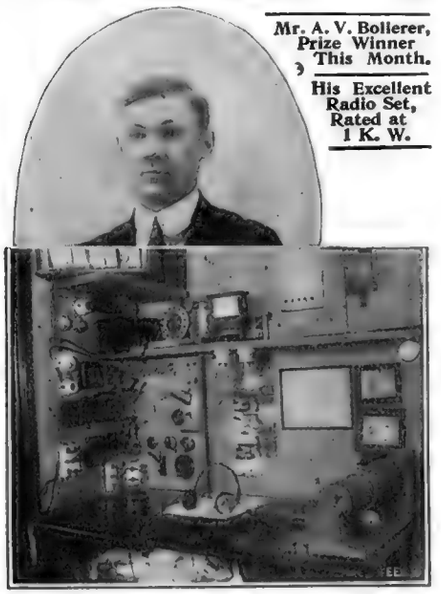
AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

WIRELESS STATION OWNED BY ALEXANDER V. BOLLERER.

The sending set of my station comprises a Blitzen 1 K.W. transformer, 110 volt



Mr. A. V. Bollerer, Prize Winner This Month.

His Excellent Radio Set, Rated at 1 K. W.

rotary gap with an oscillation transformer and suitable condenser, also a key with large heavy contacts. The receiving set consists of the following: Long wave loose coupler having a Murdock variable condenser shunted across the secondary, with a condenser also in series to vary the short wave length of incoming stations.

In the secondary I have an E.I.Co. sliding plate condenser in shunt, the two latter condensers are controlled by the two S.P.S.T. switches on the switchboard shown at the left of the illustration.

Now a word about the detectors. There are four, one silicon, one galena, one Audion and a Radioson, which are connected to the loose coupler by a switch system. There are two D.P.D.T. switches employed, the leads from the secondary of the coupler running to the center of one, and the center pole of the second switch connected to one side of the other, thus allowing the operator to use either detector by a throw of the switch. Storage batteries are the source of current to light the Audion filaments.

There are two sets of 'phones in the station, one Brandes' 3,200 ohm Navy, which is shown on the table, and the other one E.I. Co. 3,000 ohm Government set. By means of the four point switch it is possible to connect either pair of 'phones to the detector.

The two aerials which are employed with this set may be used independent of each other, or together as the operator desires. One is composed of two wires 50 feet high and 80 feet long and the other 275 feet long and 85 feet high; both are made of phosphor bronze wire.

My station is in my bedroom and it affords me great pleasure to spend the evening there listening to various stations working. Many evenings when Arlington is sending, or some other powerful station, I can lay the receivers on the table, go to bed and still hear them sending. Then when I have had enough I can shunt the 'phones by means of a small switch on my bed.

I am getting very good results with this station and hear many amateurs within a radius of 500 miles. I can hear a ¼ K.W. set 250 miles away and a ¾ K.W. set 800 miles from my station. Within 300 miles my signals can be heard very strongly. Many times I hear Key West and Colon working. With the 'phones on the table, time from Arlington and Key West is received very often. I can hear N.A.R., Key West; N.A.X., Colon; and a number of other long distance stations. I have a radio license from the government and my call is 1 V.H.

I would like to hear from other amateurs within my radius and would be highly pleased to receive photographs of their stations or exchange pictures of our respective sets.

ALEXANDER V. BOLLERER.
New Britain, Conn.

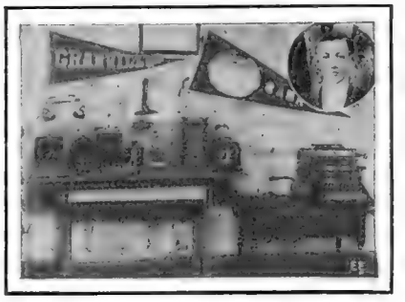
R. H. HOWE'S RADIO STATION.

Wireless telegraphy has come into practical use so rapidly that the majority of the people hardly realize the vast work that is being accomplished, especially among the amateurs, along this line.

It may be interesting to know that my interest along the line of wireless was created by purchasing an E. I. Co. 10 cent detector.

From then on I have been constructing and adding more instruments to my set until now I have the outfit which you see in the accompanying illustration.

The transmitter consists of a 1½ inch Bull Dog spark coil, helix, stationary gap, one Leyden jar and a glass plate condenser. The source of power is a 6 volt, 60 A. H. storage battery. A telegraph sounder and



Radio Set of R. H. Howe.

a portable key is connected to a telegraph line running to the home of a friend a few houses away.

Due to the lack of alternating current in our town, I am unable to transmit to any great distance, but I get splendid results from my receiving set. N.A.R. comes in very distinctly and I get the time and copy press from N.A.A. daily. I copy the weather forecast for Ohio, sent out daily by Ohio State University and I display it at our High School. I also hear many commercial stations and nearby amateurs.

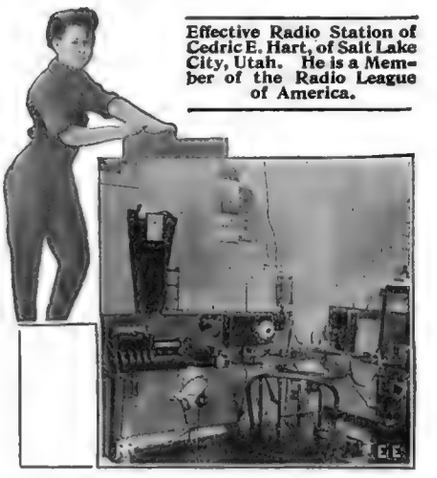
I hold a government amateur license, my official call being 8 A.B.R.

RICHARD H. HOWE
Granville, Ohio.

AMATEUR RADIO STATION OF CEDRIC E. HART.

The photograph and description of my station which are submitted herewith, I hope to see among those published in the Amateur Radio Station Contest.

The receiving set is as follows: 4,000 meter Marconi type loose coupler, Murdock variable condenser, E.I.Co. Junior fixed condenser, a high toned (high pitch) buzzer test, galena, perikon and silicon detect



Effective Radio Station of Cedric E. Hart, of Salt Lake City, Utah. He is a Member of the Radio League of America.

ors as well as an Audio-Tron bulb and a Brandes' 2,000-ohm headset.

The transmitting outfit comprises ½ K.W. Thordarson transformer, kick-back preventer, commercial key, rotary and fixed gaps, .01 M.F. condenser (under receiving table) and also an oscillation transformer, with a helix connected in series with the antenna which is 94 feet long, 50 feet high at one end and 20 feet at the other, containing four wires of No. 14 "Antenium" wire spaced 2 feet apart and then run through a large lightning switch to the set.

Among the stations that I receive are the following amateur, commercial and experimental ones: 6 P.A., 6 R.C., 6 A.C.S., 6 Z.V., N.P.L., N.P.K., N.P.E., N.P.R., N.P.M., K.J.A., K.P.A., K.P.H. and many others that I can not locate.

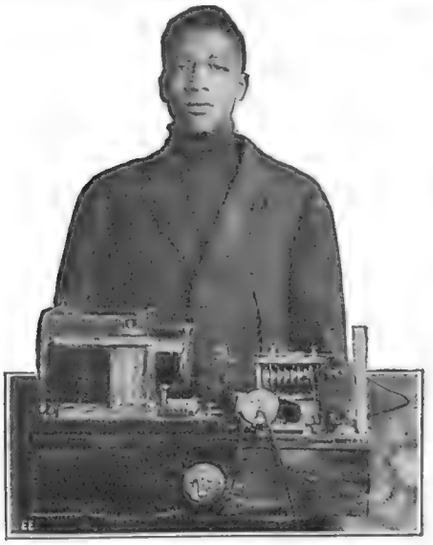
I am a member of several radio clubs, including the "Radio League of America" and "The Utah Radio Research Association."

CEDRIC E. HART.
Salt Lake City, Utah.

Don't forget your wireless set during the vacation period. If you go away for a trip take at least a small receiving set with you. It always pays.

PORTABLE WIRELESS SET OF LILBERT YOUNG.

The author takes great pleasure in sending in this illustration and description of his portable radio station. The receiving



Lilbert Young's Home-made Radio Outfit.

set consists of a large loose coupler, a Jove mineral detector, fixed and variable condensers and a 1,000-ohm Brandes' 'phone. For sending there is used a ½-inch spark coil, an E.I. Co. key, glass plate condenser, a "pancake" helix and a stationary spark gap. These instruments are mounted on a neat cabinet which has a small switch in front that controls the buzzer test and shunts the detector. A D.P.D.T. switch is also located on the left side, which is a very convenient place. With the exception of the 'phone and detector all instruments are home made. This station is used mostly for receiving and on favorable nights many distant commercial stations come in very loud.

The sending range is not so great, due to the fact that such a small coil and aerial only 40 feet long and 30 feet high are used. The writer is very much pleased with the results he has obtained with this station and proud to say that many useful ideas about its construction came from *The Electrical Experimenter*. My call is L.Y. and I will be glad to hear from amateurs within a radius of three miles.

LILBERT YOUNG.

Indianapolis, Ind.

CORRECTION NOTICE.

We are asked to state that the station shown on page 626 of our March issue of the magazine is not the property of the Minnesota Wireless Association, but of the American Telegraph School of Minneapolis, Minn.

RADIO TAUCHT IN PRISON.

Wireless telegraphy has been introduced by Warden George W. Kirchwey at Sing Sing prison, New York, as a part of the curriculum of the prison schools. Most of the inmates are proficient in "prison wireless," the term applied to the underground system of relaying news to and from the prison, and are expected to quickly master the new system. Henry Leeb, a graduate of the Massachusetts Institute of Technology, was the first lecturer on the subject. It is planned to train the operators thoroughly in the use of wireless, so they can take a job on land or sea when released.

THE RADIO SET OF J. Y. PARSONS, JR.

Herewith is an illustration of my wireless station, all of which is home made, with the exception of the spark coil, 'phones and key.

The receiving set consists of a loose coupler, fixed condenser, variable condenser, single slide tuning coil used as loading coil, 1,000-ohm 'phones, buzzer test and galena, silicon and iron pyrites detectors. In the sending set there is a 2-inch coil, glass plate condenser, spark gap, helix and key. I use dry cells as a source of power for the transmitter. The aerial is 50 feet long and 40 feet high at one end and 50 feet at the other. The instruments are protected by fuses and a lightning switch. Very

Radio Set of J. Y. Parsons, Jr.

good results are obtained with this outfit.

J. Y. PARSONS, JR.

Kansas City, Mo.

Amateur News

Radio Club of America.

The Radio Club of America announces the election of the following officers for the year 1916: President, Edwin H. Armstrong; Vice President T. Johnson, Jr.; Treasurer, Ernest V. Amy; Corresponding Secretary, David S. Brown; Recording Secretary, Thomas J. Styles. Directors—Paul F. Godley, Alfred P. Morgan, Harry Sadenwater, Jos. A. Fried, Walter S. Lemmon. Office of the Secretary, 206 W. 86th St., New York City.

The annual election meeting of the club was on Saturday evening, January 8, at Columbia University.

Mr. William Dubilier presented a paper on "Portable Aeroplane and Trench Radio Sets." Special consideration was given to a type of apparatus developed by the author for utilizing direct currents in producing musical notes without the use of a motor generator set and revolving spark gaps. Mr. Dubilier described in detail, with lantern slides and apparatus, the installations now being used by the Allies for directing artillery fire, and communicating between trenches.

Central Radio Association News.

The membership of the Central Radio Association as shown by the supplemented Call Book is considerably in excess of one thousand. Amateurs of the better class are urged to request enrollment blanks of the secretary, H. B. Williams, at Chanute, Kans. No charge is made.

The new map of the C. R. A. is now ready for distribution. Copies may be obtained from Assistant Secretary S. Kruse at Lawrence, Kans.

All C. R. A. stations may be located on this map and the distance between any two rapidly and accurately determined.

Records of the Month: 9DM—H. C. Ziesenis, Lawrence, Kans., to Portsmouth, Va. Input, 1,000 watts. Distance, 1,250 miles. Time, night. 1.25 miles per watt.

Definition of the term "Record."—Transmission of connected matter over a distance in excess of one mile per watt input for night work or one mile per three watts input for daylight work shall constitute a record.

The Junior Radio Club, Pensacola, Fla.

The Junior Radio Club held its first meeting at the home of Edwin Copas, president, at which the following officers were elected: Edwin Copas, president; Oliver Williams, secretary; Fred Gillmore, operator. Every amateur is invited to join. Address all communications to Fred Gillmore, 127 W. Gregory St., Pensacola, Fla.

Wireless Station Built on University Campus.

A wireless station, which can receive messages from as far away as the government station at Radio Virginia, is being operated under the supervision of the physics department and the course in electrical engineering of the University of Wisconsin. Its aerial, which has a sweep of 140 feet, is 130 feet high and 15 feet wide, stretched from the chimney of one of the engineering buildings.

Time signals from the Arlington station at Washington are received twice every day and the report comes in very clear and strong. Although the apparatus is really an experiment, it is one of the best stations in the State.

Tampa, Fla., Wireless Enthusiasts.

Tampa, Fla., local amateur radio operators met at the Y. M. C. A. a short time ago and organized the Tampa Radio Club. Officers are: President, John Fogarty; vice-president, Victor McIlvaine; secretary-treasurer, Houston Wall.

The largest amateur station in Tampa is owned by Houston Wall. Other operators at the meeting were John Fogarty, Emilio Pons, Frank Cooper, Victor McIlvaine, Lamar Boyette, Livingstone Lesley, Leslie James, Harry Johnstone and Wesley Thaxton. The club requires that members shall be able to send and receive at least five words a minute.

Omaha Boy is World's Best Wireless Keyman.

A. R. Gerhard, of Omaha, Nebr., won the "champion wireless operator of the world" honor at the Panama-Pacific International Telegraphers' tournament, held recently at San Francisco. After winning this prize, he entered the "land" telegraphy department contest and took third honors.

Gerhard's home is at 2714 Jackson street. He learned wireless telegraphy by experimenting at his home. He has made several trans-Pacific trips as wireless operator.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Wireless Course Popular at Loyola University.

Following the installation recently at Loyola University, New Orleans, La., of a powerful wireless station, interest in the course in wireless telegraphy has been steadily increasing. Classes are held three nights a week and a miniature sending and receiving apparatus is now in the course of construction in a large class room to be used for demonstration purposes.

Messages are being received from points 1,500 miles distant in South America, the United States station at Arlington and from stations on the Great Lakes and in Mexico. Prof. A. E. Porter is in charge of the class.

The Topeka Radio Club.

The Topeka Radio Club was organized a little over a year ago with a limited membership of twelve. The purpose of the club is to promote and regulate activities in and around Topeka, Kan. Six of the members have secured Government licenses and the whole club will be composed of licensed members in a short time.

The following officers have been elected for the year 1916: President, E. Broberg; vice-president, J. Keating; secretary and treasurer, W. Beasley; sergeant-at-arms, R. Morehouse.

All communications should be addressed to the secretary, Wm. A. Beasley, 1517 Western avenue, Topeka, Kan.

Radio Association of Long Island.

The Radio Association of Long Island was formed on Nov. 3, 1915. The following officers were elected for the ensuing year: President William Woolser; Vice-President and Secretary, Edwin Stewart; Treasurer, Charles Phelan; Librarian, George Coakley; Manager of the Operating Staff, Walter Davison.

The object of this association is to further the progress of radio communication over the whole of Long Island. The association will be glad to hear from any amateurs regarding any matter concerning this association. Address all communications to the Secretary, G. Edwin Stewart, 45 Hillside Ave., Rockville Center, L. I.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, TILL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of December, 1915. (Continued.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
	SIXTH DISTRICT—(Cont'd.)		
6ED	Farish, Edward T.	1609 W. Lewis St., San Diego, Cal.	.5
6FV	Foulon, Fred	423½ E. 29th St., Los Angeles, Cal.	1
6SF	Fuller, Sidney	1718 S. Main St., Los Angeles, Cal.	.5
6GN	Grossnicle, Russell R.	Lordsburg, Cal.	.5
6JO	Hayden, Jack	246 N. 22d Ave., Los Angeles, Cal.	.5
6PV	Henn, Charles W.	1468 47th Ave., San Francisco, Cal.	.5
6RK	Kelley, Roger M.	399 S. Wilson Ave., Pasadena, Cal.	.5
5VK	Kemp, Victor H.	803 E. 28th St., Los Angeles, Cal.	.5
6GT	Knudsen, George	418 Banks St., San Francisco, Cal.	.5
6HA	Kreamer, John A., Jr.	222 W. 33d St., Los Angeles, Cal.	.5
6LG	Lee, George R.	134 N. Johnstone St., Los Angeles,	1
6JM	McCarger, J. L.	1413 16th St., Oakland, Cal.	1
6EM	McGuire, Edward	55 Dame St., San Francisco, Cal.	.5
6WN	McKinzie, Wm. H.	664 11th St., Oakland, Cal.	.5
6PR	Murkett, Philip T.	126 W. Olive Ave., Redlands, Cal.	.5
6HM	Murphy, Harold J.	Mountain View, Cal.	.5
6TA	Nelk, Teddy J.	848 E. 28th St., Los Angeles, Cal.	.5
6AG	Neuser, Arthur A.	280 N. 22d Ave., Los Angeles, Cal.	.5
6FP	Parke, Francis M.	582 N. Park Ave., Pomona, Cal.	.5
6CM	Phillips, Carroll J.	1261 St. Charles St., Alameda, Cal.	.5
6EX	Remelin, Eldred L.	Perris, Cal.	.5
6FR	Salome, Drederic W.	1493 Harrison St., Oakland, Cal.	.5
6HS	Schnarr, Henry J.	3611 Allendale Ave., Oakland, Cal.	.5
6AY	Schneider, August G.	530 S. Chicago St., Los Angeles, Cal	.5
6SM	Smith, Seth	78 Peralta Ave., San Francisco, Cal.	.5
6WR	Spare, Wilson	3737 3d St., San Diego, Cal.	.5
6RE	Stoddard, Harold	1309 8th St., Oakland, Cal.	.5
6JU	Tait, Jack D.	1264 Oxford St., Los Angeles, Cal.	.5
6WA	Van Why, Forbes W.	2012 N. Broadway, Los Angeles, Cal.	1
6WO	Walters, Wilbur E.	410 E. 2d St., Lordsburg, Cal.	.5
6NW	Webb, Morrison R.	541 18th St., Oakland, Cal.	.5
6DX	Wheelock, Chas.	143 N. Lime St., Riverside, Cal.	.5
6HW	White, Howard	822 E. 4th St., Santa Ana, Cal.	.5
	SEVENTH DISTRICT.		
7CQ	Christianson, Herbert	112 W. Poplar St., N. Yakima, Wash.	.5
7NC	Clodfelter, Nolan A.	1221 E. Madison St., Portland, Oreg.	.5
7DI	Goodger, Donnan P.	4214 Interlake Ave., Seattle, Wash.	.5
7GF	Gibbs, Francks F.	512 E. 4th St., Hood River, Oreg.	.5
7GO	Hagen, Bert W. R.	217 N. Miles Av., N. Yakima, Wash.	.5
7HQ	Hayden, Henry T., Jr.	Port Townsend, Wash.	.5
7FQ	Lewis, Harold H.	R. F. D. No. 2, Lewiston, Idaho.	.5
7GL	Manca, Angelo C.	1816 E. Jefferson St., Seattle, Wash.	.5
7NS	Sanborn, Ned	501 M. St., Hoquiam, Wash.	.5
7SC	Sparks, A. Eldon	1029 Walnut St., Baker, Oreg.	.5
7VN	Van Olinda, Oliver S.	R. F. D. No. 1, Vashon, Wash.	1
7WA	White, Ruel	313 W. 4th St., Vancouver, Wash.	1
	EIGHTH DISTRICT.		
8RS	Alger, Allan E.	214 Arizona Ave., Lorain, Ohio.	1
8AMJ	Allan, Donald	3237 Dayton Ave., Cincinnati, O.	.5
8ML	Berman, Isidore A.	849 Windham St., Cincinnati, Ohio.	.5
8ANB	Bower, Stanley	162 Elizabeth St., Marine City, Mich	.5
8AJ	Custis, Walter E.	468 Buchtel Ave., Akron, Ohio.	.5
8CI	Danforth, Gordon F.	16 Tuxill Sq., Auburn, N. Y.	.5
8FP	Esslinger, Elwin	523 Miller Ave., Ann Arbor, Mich.	1
8SB	Evans, George M.	Tippecanoe City, Ohio.	.5
8DD	Fleckner, Harry K.	1007 Sheridan Ave., S. W., Grand Rapids, Mich.	.5
8ANF	Frase, Ralph L.	546 E. Buchtel Ave., Akron, Ohio.	.5
8HE	Grotticelli, Emil	115 Montclair Ave., Grafton, Pa.	1
8ANC	Israel, Dorman	3426 Burnet Ave., Cincinnati, O.	.5
8PU	Jones, Winferd E.	87 Holland Ave., Lancaster, N. Y.	.5
8LF	Loebs, George	1139 St. Paul St., Rochester, N. Y.	.5
8ND	McCarty, Alison	38 Morgan St., Oberlin, Ohio.	.5
8SC	Marshall, Leonard A.	2234 Putnam St., Toledo, Ohio.	.5
	EIGHTH DISTRICT (Cont'd.)		
8WL	O'Leary, Hilary	Montclair St. and Stratford Ave., Crafton, Pa.	1
8DL	Osterbrock, Ed. and H., Jr.	4152 Webster Ave., Norwood, Ohio.	.5
8SO	Preston, Menzo D.	424 E. Main St., Wellington, Ohio.	.5
8ANE	Russell, Fred W.	909 Kensington Ave., S. W., Grand Rapids, Mich.	.5
8ANI	Seidel, Frank	1357 Tennessee Ave., Dormont, Pa.	.5
8QO	Smith, Grant A.	408 Jay St., St. Clair, Mich.	.5
8BU	Stellrecht, Howard	15 Clark St., Lancaster, N. Y.	.5
8ANH	Stewart, Donald G.	2235 Putnam St., Toledo, Ohio.	.5
8KY	Thomas, Earl R.	712 Louisa St., Williamsport, Pa.	.5
8AND	Thurnes, Darley	187 W. Chestnut St., Akron, Ohio.	.5
8RT	Toy, Miles N.	121½ W. Market St., Lima, Ohio.	1
8QT	Watson, Jas. G.	108 Maple Ave., Cincinnati, Ohio.	.5
8EQ	Weekman, Frank L. and Verne W.	115 Weeks St., Jamestown, N. Y.	.5
8ADF	Werner, Herman E.	41 Fay St., Akron, Ohio.	.5
8RQ	Wescott, Alva F.	Ashville, N. Y.	1
8AIN	Williams, John C.	60 Hollister St., Cincinnati, Ohio.	.5
8ANG	Wright, Harry D., Jr.	1116 W. Market St., Lima, Ohio.	.5
	NINTH DISTRICT.		
9JJ	Alvested, Clarence M.	819 13th Ave., S. Minneapolis, Minn.	.5
9HA	Andrew, Warren	Boulder, Colo.	.5
9CL	Beech, Guy L.	Clarinda, Iowa.	.5
9KS	Bennett, Harold	Clarinda, Iowa.	.5
9WQ	Black, Harry N.	Independence, Iowa.	.5
9CT	Brailsford, Harry D.	323 W. Broadway, Louisville, Ky.	.5
9KJ	Briggs, Walter C.	4525 Dupont Ave., S., Minneapolis, Minn.	.5
9WR	Burghardt, R. Douglas	5023 N. 24th St., Omaha, Nebr.	.5
9WU	Church, Arthur B.	Lamoni, Iowa.	1
9DD	Ederer, Lothar A.	6347 Kenmore Ave., Chicago, Ill.	1
9JX	Griffiths, Robert E.	4704 Fulton St., Chicago, Ill.	.5
9CH	Grosscupt, Harry W.	3746 Giddings St., Chicago, Ill.	.5
9JO	Gustafson, Gerald	214 Crawford St., Boone, Iowa.	.5
9BF	Heck, Lawrence F.	1239 Center St., Racine, Wis.	.5
9CW	Heise, Elmer B.	513½ Franklin St., Michigan City, Ind.	.5
9WV	Hoffman, Erich A.	819 Laramie St., Atchison, Kans.	1
9CV	Johnston, Roderick E.	Boulder, Colo.	.5
9IB	Koch, Emerson L.	3032 E. Michigan St., Indianapolis, Ind.	.5
9WT	Kelley, Edward L.	551 Parkside Ave., Chicago, Ill.	.5
9JC	Lewis, W. Turner, Jr.	1500 Main St., Racine, Wis.	1
9BO	McBride, Ralph M.	Tabor, Iowa.	.5
9AE	McGee, Paul J.	2609 Richmond Ave., Mattoon, Ill.	.5
9OT	McKee, Charles R.	203 N. 2d St., Atchison, Kans.	1
9WP	McKeever, Thomas	1703 W. 104th Pl., Chicago, Ill.	.5
9DW	Malott, Alfred F.	945 W. 30th St., Indianapolis, Ind.	.5
9CO	Maupin, Ross T.	2436 Indiana St., Kansas City, Mo.	.5
9AJ	Nell, Raymond B.	Clinton, Iowa.	.5
9WS	Patterson, Coy V.	3528 Winsor Ave., Kansas City, Mo.	.5
9BL	Perl, Raymond H.	2533 N. Richmond St., Chicago, Ill.	1
9HU	Pilgram, G. W. & John C.	710 S. 19th St., St. Joseph, Mo.	.5
9SQ	Rea, Richard S.	1028 Prospect St., Elgin, Ill.	.5
9AT	Rueschau, Harry R.	3748 Clifton Ave., Chicago, Ill.	1
9OP	Sandifer, Robert P.	325 N. Atchison St., El Dorado, Kas.	.5
9KV	Sauer, August	809 N. Temple Ave., Indianapolis, Ind.	.5
9DZ	Seaman, Walter A.	734 Christiana Ave., Chicago, Ill.	.5
9HP	Stevens, Kenneth	2032 N. 7th St., Sheboygan, Wis.	.5
9AA	Stone, Richard G.	717 Douglas Ave., Elgin, Ill.	.5
9IH	Talbott, Edward	1114 W. 34th St., Indianapolis, Ind.	1
9WV	Wireless Trio, The	(See Hoffman, Erich A.)	

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of January, 1916.

Call signal	Owner of station.	Location of station.	Power kilowatts.
	FIRST DISTRICT.		
1ANH	Aldrich, George E.	9 Simonds Rd., Melrose, Mass.	.5
1JL	Ayres, Richard T.	10 Common St., Charlestown, Mass	.5
1ANB	Bacuinka, Peter L.	137 Dorchester St., Worcester, Mass	.5
1ANJ	Bailey, Charles E.	51 Chestnut St., New Britain, Conn.	.5
1AED	Beebe, William J.	42 Ridgewood Pl., Springfield, Mass	.5
1KJ	Blake, Sidney S.	25 Elm St., Westerly, R. I.	.5
1VH	Bollerer, Alexander V.	77 Linwood St., New Britain, Conn.	.5
1AEJ	Bradshaw, Wesley B.	16 Centre St., New London, Conn.	.5
1ANT	Buck, Richard C.	44 Linden St., Reading, Mass.	.5
1RC	Chase, Frank H.	55 Washington Ave., Chelsea, Mass.	.5
1AEG	Cornwell, Wm. J.	24 Clark St., Cambridge, Mass.	.5
1AEY	Cross, Leon F.	3 Vine St., Tilton, N. H.	.5
1ANU	Davis, Clifton D.	8 Cedar Court, Wakefield, Mass.	.5
1AEZ	Daynes, Frederick A.	380 E. St., South Boston, Mass.	.5
1AEA	de Mars, Paul A.	43 Vine St., Lawrence, Mass.	.5
1AEE	Dickson, Wm. E.	59 Camden Circle, Quincy, Mass.	.5
1AER	Entwistle, Guy R.	Everett, Mass.	.5
1ANI	Erwin, Wm. C.	50 Beechwood Ave., Watertown, Mass.	.5
1ANF	Fay, Arthur N.	257 B'way, Chicopee Falls, Mass.	1
1AEB	Flint, Arthur W.	4 Green St., Wakefield, Mass.	1
1ANA	George, Eldridge B.	211 Arsenal St., Watertown, Mass.	.5
1AEF	Gilman, Samuel	63 Chestnut St., Chelsea, Mass.	.5
1ANG	Godfrey, Warren	117 Park St., West Roxbury, Mass.	.5
1AEH	Halligan, Wm. J.	23 Devens St., Charlestown, Mass.	.5
1AF	Hart, Emery A.	80 Melborne St., Portland, Me.	.5
1AEV	Hayden, Kenneth L.	44 Chester Ave., Winthrop, Mass.	—
1ANN	Holbrook, Frank L.	36 Moody St., Portland, Me.	.5
1AET	Holmes, Phillip B.	21 Rocklegde Rd., Newton Highlands, Mass.	.5
1AEP	Hunkins, Fred L.	17 Center St., Laconia, N. H.	.5
1AEM	Johnson, Gilbert W.	75 Ontario St., Providence, R. I.	.5
1ANK	Kurth, Henry L. R.	126 Columbia St., Cambridge, Mass	.5
1WR	Lane, Chauncey C.	73 S. Water St., New Haven, Conn.	.5
1ANL	Leonard, James A.	30 Newhall St., Lynn, Mass.	.5
1AAR	Lewis, Wm. H., Jr.	226 Upland Rd., Cambridge, Mass.	.5
1SP	Lisker, Wm.	141 Chester Ave., Providence, R. I.	.5
	FIRST DISTRICT—(Cont'd.)		
1AEL	Little, Noel C.	8 College St., Brunswick, Me.	.5
1ANE	Lyman, Edward W.	25 Pine St., Pittsfield, Mass.	.5
1BP	Mills, Bruce M.	48 Crescent St., Rutland, Vt.	.5
1AEX	Mosher, Albert E.	35 Forest St., Lawrence, Mass.	.5
1ANO	Osborne, Roger W.	15 Olney Pl., East Lynn, Mass.	.5
1GN	Palmer, Chas. A.	57 Wollaston Ave., Arlington Hts., Mass.	.5
1BY	Parker, Leighland F.	Island Pond, Vt.	1
1EN	Pierce, Fred'k H.	High School Bldg., Lewiston, Me.	1
1AMB	Pratt, Phinehas W.	100 Harvard St., Everett, Mass.	.5
1AEO	Redfield, Kendall A.	18 Mace Pl., Lynn, Mass.	.5
1AEI	St. John, Forbes	Darien, Conn.	.5
1IN	Schwartz, Walter P.	3 Thatcher St., Hyde Park, Mass.	.5
1ANM	Senior, Wm. B.	68 Mechanic St., Westerly, R. I.	.5
1AEQ	Shaw, Arthur M.	49 Washington Blvd., Springfield, Mass.	.5
1AL	Sinnett, Chester M.	Bailey Island, Me.	.5
1AEK	Sleeper, Joseph N.	Sanbornton, N. H.	—
1AEU	Southworth, Arthur P.	122 Chestnut St., Wakefield, Mass.	.5
1AES	Stone, Perry	15 West St., New London, Conn.	.5
1ANS	Stoughton, Edgecombe	198 Ocean Ave., Portland, Me.	.5
1AC	Stubbs, Edward T.	1 Bennett St., Sanford, Me.	.5
1HD	Sullivan, John F.	485 E. 6th St., S. Boston, Mass.	.5
1GQ	Thompson, John E.	3 Grand St., Reading, Mass.	.5
1KO	Upham, Howard B.	20 Mt. Bowdoin Ter., Boston, Mass.	.5
1ABW	Whitcomb, Raymond E.	12 Gerry St., Stoneham, Mass.	.5
1AG	Wilbur, Harold S.	R. F. D. No. 6, Auburn, Me.	.5
1AEN	Winstanley, Robert	22 Battery St., Boston, Mass.	.5
1AEW	Whittaker, Laban H.	38 Corona St., Dorchester, Mass.	.5
	SECOND DISTRICT.		
2AIX	Ballentine, Harold E.	17 Sharp Ave., Pt. Richmond, N. Y.	.5
2AIF	Betts, Philadner H.	Montclair, N. J.	.5
2AII	Brewster, Carleton, Jr.	2 Ocean Ave., Bay Shore, N. Y.	.5
2AJF	Broome, Frank H.	315 Chestnut St., Roselle Pk., N. J.	1
2AID	Butler, Robert M.	396 E. 16th St., B'klyn, N. Y.	.5
2AJC	Carr, John	204 W. 149th St., New York, N. Y.	.5

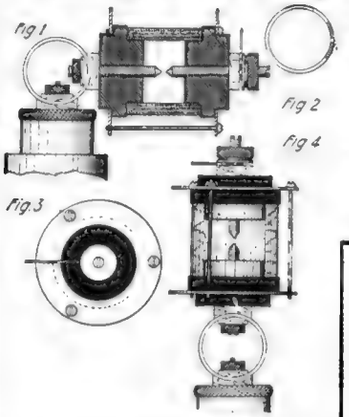
(To be continued)

LATEST PATENTS

Intensifier for Spark-Plugs.

(No. 1,169,744; issued to Alexis F. Gillet, assignor to Jubilee Manufacturing Company.)

This device is intended to pile up

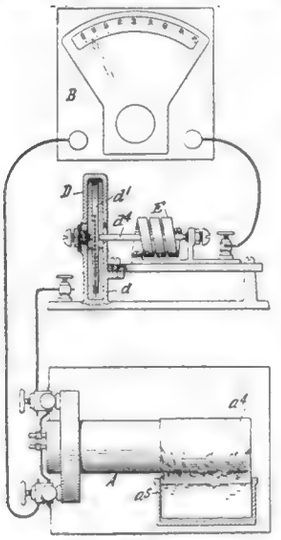


the secondary surges in a gasoline engine spark coil ignition circuit, and in this way to create a much fatter and more powerful discharge at the inner gap electrodes of the spark plug than is procurable otherwise. The intensifier is attachable, as perceived, to the upper binding post of the spark plug.

A Thermo-Electric Humidity Instrument.

(No. 1,169,617; issued to Edward W. Comfort, assignor to Buffalo Forge Company.)

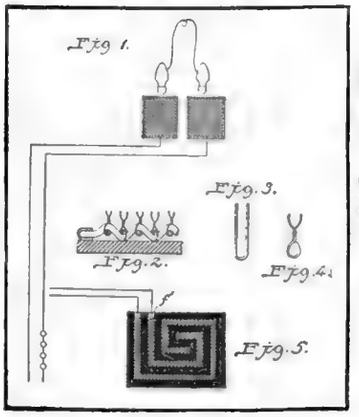
A new design of thermo-electric humidity instrument which compensates itself for changes in temperature and the corresponding effects on the electric circuit. It includes a compound thermo-electric battery A, which has proper absorbing members a4 dipping into some water at a5. A galvanometer calibrated to read degrees of humidity is shown at B, while at E and D are shown respectively the thermic-motor and rheostat. This motor in turning the shaft d4 a short way about its axis, causes the rheostat wheel d1 to dip more or less of its points into a mercury bath d. The thermic-motor and rheostat arrangement is for the purpose of altering the current in the circuit in proportion to the change in the dry bulb temperature of the air; thus causing the apparatus as a whole to read absolutely correct in any location.



Electrical Dancing Mat.

(No. 1,178,444; issued to Stephen Goldini.)

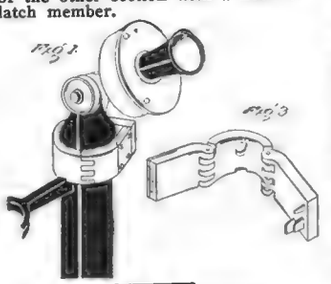
An electric spark-producing dancing mat for either A.C. or D.C. circuits. This invention embodies a mat or mats on which the dancer treads, the tread surface of which mat is provided with a plurality of upstanding wires on which the artist treads during the act of dancing. These upstanding wires of the one or more mats are electrically connected with a source of electrical current, either direct or alternating, so that, when an operator treads upon the surface of the mat with metallic-soled shoes, a circuit is completed, with the result that electric flashes are produced.



Telephone Lock.

(No. 1,172,614; issued to John E. Lavalley.)

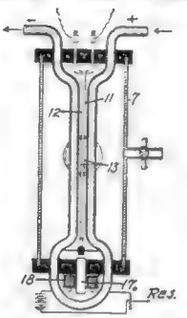
The object of this invention consists in constructing a device for locking telephones and to be made in the form of a collar adapted to embrace the standard of the instrument. Further, the collar includes a number of sections hingedly connected. The collar is provided at the free end of one section with a lock mechanism and the free end of the other section with a hook or latch member.



Electro-magnetic Indicator.

(No. 1,172,018; issued to Reginald A. Fessenden, assignor to Samuel M. Kintner and Halsey M. Barrett.)

This apparatus is of the string galvanometer type. The field conductors are kept especially cool, so that very heavy currents may be passed through the instrument as by passing liquid air through such conductors, which, of course, are made hollow for the purpose set forth. Several hundred amperes may be passed through this instrument. The inclosing vessel 7 is preferably vacuous. The tension on the looped conductor 11 and 12 is variable by a D.C. excited magnetic tension-control 17 and 18, connected up with a battery and rheostat, as perceived. A beam of light is passed crosswise through the chamber 7, which contains proper openings, and any movement of the enlarged portions of the looped conductor as at 13, is thus thrown on a scale or other apparatus and its various configurations there noted (visually or photographically). This instrument has

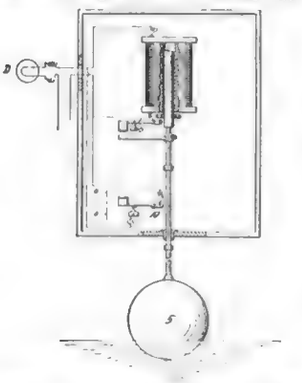


a very small time period owing to the unique design involved.

Electric Water Lever Indicator

(No. 1,171,405; issued by Dave Ablon.)

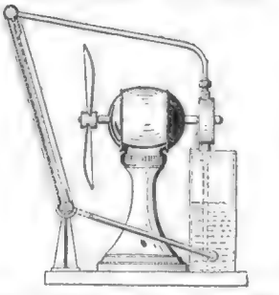
An ingenious design of water lever indicator, whereby an incandescent lamp D, is made to glow at different degrees of brilliancy according to the depth of water in the tank, which in turn causes a float 5 to rise and fall proportionately. When the float is at its lowest extremity, it closes a switch 10 causing the lamp D to burn directly on the A.C. service mains. As the water, and conjointly the float 5 rise, the iron core attached to the upper end of same extends farther within the solenoid winding, thus creating more impedance and in consequence the lamp D grows dimmer in proportion. A trip switch is actuated when the float and its vertical shaft 6 have reached the upper limit of their movement which opens the solenoid circuit.



Air Cooling and Aromatizing Fan.

(No. 1,173,497; issued to John Farley.)

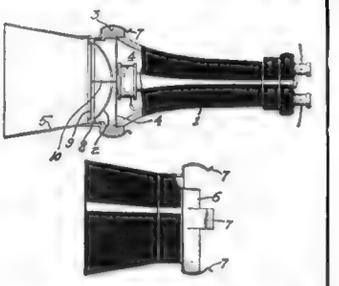
According to this invention an air fan is provided, driven in any suitable manner, say by an electric motor, and mounted in front of the fan, in such manner that the air from the fan is driven therethrough, is a grid or the like device made of a series of tubes or ducts, the sides of which nearest the fan are open, or the tubes may be perforated. Means are provided for causing a circulation of water or other liquid to take place through the tubes of the grid. The liquid may be merely water for the purpose of cooling the air and entrapping dust and fiber which is then carried away in the water flow, or water impregnated with disinfectants or perfume.



Telephonic Amplifier.

(No. 1,179,117; issued to Emily D. Lowry.)

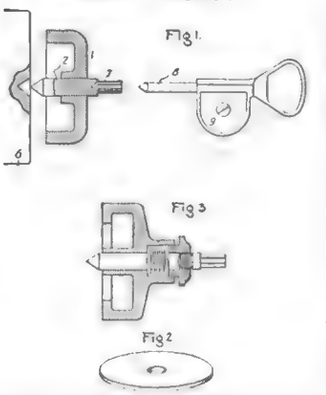
An amplifier intended for use on ordinary telephone receivers, enabling the user to lay the receiver on the table, thus leaving both hands free.



The mechanism comprises the usual telephone receiver 1 having the cup 2 with the ring 3 thereon and the diaphragm 4 thereon, in combination with the sound tube 5 having the rim 6. This telescopes on the ring 3; the spring clips 7 engage the ring to hold the rim in place; the ring 8 screws into the tube. The auxiliary diaphragm 9 is carried by the ring 8, and the pin or strut 10 is fixed to the center of the auxiliary diaphragm.

Magnetic Connector for Speed Indicator.

(No. 1,168,037; issued to Frank Short, assignor to General Electric Company.)



This scheme utilizes the principle of magnetism to provide a neat and handy attachment which will hold an ordinary speed indicator or counter in position on the end of a rotating shaft 6. The cup-shaped member 1, is made of steel strongly magnetized and the center stem 2 is also of steel and made to slide quite snugly through the opening in cup 1. A spring chuck 7 makes firm connection with the stem of the speed indicator 8. The weight of the indicator part at 9, ordinarily will keep this portion of the instrument stationary while the template revolves. An alternative design is shown at Fig. 3, while 2 is a soft iron plate acting as a "keeper" for preserving the magnetism in the steel shell 1 when it is not in use.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 !! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

ALEC TRICITY, OF OYSTER-ON-THE-½-SHELL BAY.

FAT MAN'S JOY

Me4u
4-1

Specifications of Patent Leathers.

(Patented Black Friday 13th)

To whomsoever it may concern, consarn you:

By the knowledge of the fact that I, Alec Tricity, a spifflicated native of Oyster-on-the-½-shell-Bay, have, in spite of constant danger from the indiscriminate wielding of the Big Stick, succeeded in constructing a machine which will either kill or cure—probably the former—all men who are inclined toward stoutness, due to their having sat too long at the little round tables, guzzling the soapy foam from a growler of Pilsener's best dark brown, or to their eating too many portions of steak and onions, as well as other frightful fat foods.

This invention relates to a mechanical means for muscle mutilation, which positively reduces the proboscity of any person.

The action of this device is as follows: The patient, victim, or otherwise, stretches the noble proportions of his sylph-like figure upon the cold, hard plate, 26, with his painfully prominent protuberance pointing toward the Pole star. His dainty, naked feet are held by the strap 27, while a brass band—no connection with a German Band—passes lightly over his manly chest. 3 is a shaft supported by inlaid mahogany hangers, 18, and driven by the motor 4, belt 19 and pullev 20. Current is supplied by wire 30, with switch 29. When revolving, the shaft causes rod 9 and plate 2, too, to move with a gentle, undulating un-adulterated movement, which, as it exerts a soothing pressure, makes the fortunate patient writhe with glee, while the salty tears spring to his docile, cow-like eyes.

In the meantime, connector 8, joined to crank 31, moves the arms up and down, thus reducing the fatty accumulation, caused by too great unfamiliarity with the use of Shank's Mare. 5 is a spark coil, connected to battery 6. The secondary current, applied through shaft 3 and the connecting rods, keeps the patient in a happy flutter of enjoyment. In the meantime, the wheel 15, which carries a contact 16, operates a magnet, 13, actuated by battery 7. The armature 12, governed by spring 14 regularly opens the valve of a spraying device, 10, blowing a zephyry shower of predigested onion emulsion on the red and bulbous nose of the treated person.

A little, or chicken feather, 25, fastened to wheel 24, is run by the gears 21 and 22, supported by hangers 23. This actuates the tickling membrane at the bottom of the pedal extremities, thus keeping the patient in an amiable mood. It is highly important that only chicken feathers be used. Patients using this device are notoriously known to be "chicken" fanciers. Hens feathers would never do.

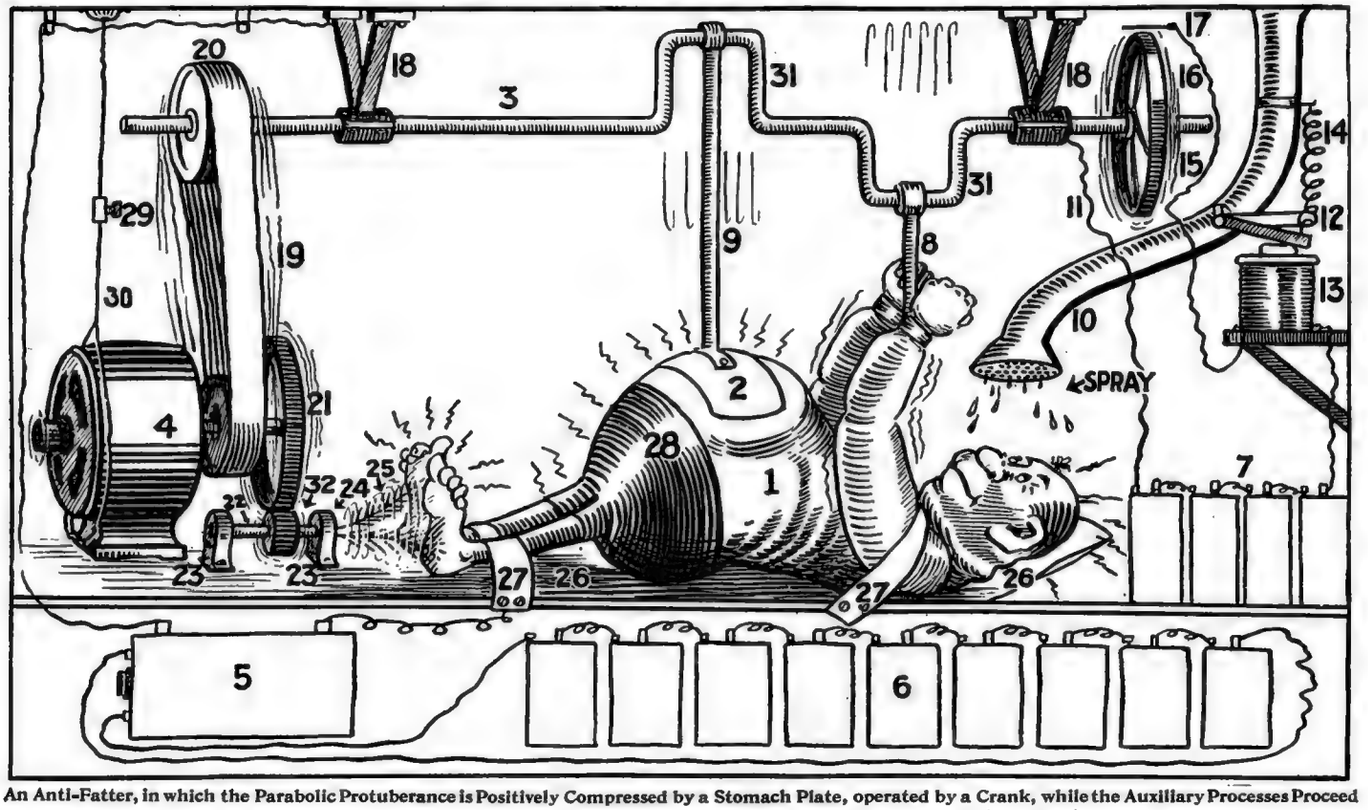
What I claim is:

1. A device which will positively cure or bust any abnormality in the region of the solar plexus.

2. A device which, while reducing the fatty degeneration, will give the victim the most powerfully pleasant prodding and poking which he ever experienced, and leave him in such a condition that he will never be able to look cross-eyed at a man's-size portion of baked beans or pigs' knuckles with sauerkraut.

3. A device which will make money in Turkish, Russian and Skowhegan baths, where all-night rounders usually finish up to sweat out their remorse at losing twenty-nine cents in a gum machine which didn't work.

4. A device which will actually perform the work of the usual Anti-Fat, Don't-be-Thin, or Have-Muscles-and-Perfect-Figure-Like-Mine preparations, which never cure, and kill much slower than this mechanical anti-fatter. There is no question about kicking the bucket with this device.



An Anti-Fatter, in which the Parabolic Protuberance is Positively Compressed by a Stomach Plate, operated by a Crank, while the Auxiliary Processes Proceed

In testimony whereat I put my name, during the third year since our cat swallowed a clothes-pin, and died of hokus-pokusmorphia, on the back steps, with its left hind foot still in position to scratch the flea which it never could find.

ALEC TRICITY,
By his attorney,
Harry Haenigsen.

Witnesses:
Will U. Diet.
O. I. Shudworra.
Lemme Bust.

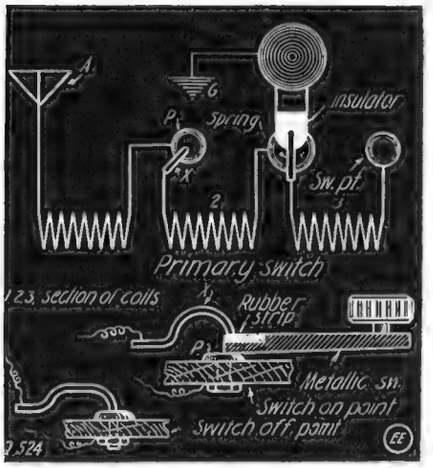
QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

Telephone Magneto.

(524.) Matt Jarosz, Chicago, Ill., asks: 1. Can the back E.M.F. of a series wound motor be used for sending in wireless telegraphy? 2. Can you give me a diagram showing how a dead-end switch is connected in a navy type loose-coupler? 3. Can a telephone magneto having four magnets be changed into a shunt wound dynamo for charging batteries.



Dead-End Elimination Switch for Loose Couplers.

A. 1. The back E.M.F. (voltage) of a series wound motor can not be used in any way for operating the sending coil in wireless telegraphy as we do not know any means of utilizing this back E.M.F. for such a purpose.

A. 2. The illustration herewith gives the connections of a very good dead-end switch which is used for the primary but a similar one can be made for the secondary coil.

A. 3. A telephone magneto can not be changed into a shunt wound dynamo very easily, but if field coils are wound over the magnets and so connected that the polarity of same does not change the polarity of the permanent magnets, it would be possible to convert this magneto into a shunt wound dynamo. A commutator will have to be added to the armature.

Audio-Tron Bulbs.

(524-A.) John Eddy, Jr., N.Y., writes: 1. Are the Audio-tron bulbs as advertised in the March issue of *The Electrical Experimenter* as sensitive as audion detectors and can they be used in the reception of undamped waves, using the "beat" system? 2. Are any other additional instruments required for detecting these continuous waves besides the audio-tron tube? 3. What are the requirements for membership in the Wireless Association of America?

A. 1. These bulbs are somewhat more sensitive than the audion because of the greater ionic generating surface obtained which is due to the increase of size of the grid and wing. These detectors are suitable for the reception of undamped waves when used in proper oscillating circuits such as the Armstrong type.

A. 2. The only instruments that will be required for operating this detector for receiving undamped waves are additional inductances and capacities properly connected. Refer to recent issues of this journal.

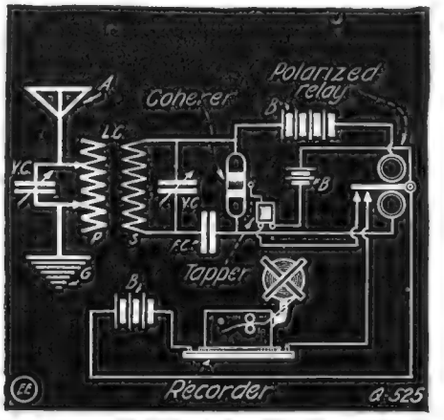
A. 3. This organization is no longer in existence.

Carbon Ball Transmitter.

(525.) F. Howell Miller, Richmond Hill, N.Y., writes: 1. Kindly give the connections for a coherer so that I can operate a tape recorder. 2. What is the price and where can a carbon ball transmitter be obtained, such as is used in the Electro-Magnet Skull described in the March, 1916, issue of *The Electrical Experimenter?*

A. 1. Herewith is given a diagram of the connections for a coherer operating a recorder.

A. 2. A suitable transmitter may be purchased from The Electro Importing Co., 233 Fulton Street, New York City. Although this transmitter is not exactly like



Coherer Wiring Diagram, Including Tape Register.

the one described in the magazine, it will do the same work and is very sensitive, which is the most important point in the construction of the magic skull.

20,000 Meter Tuner.

(526.) Morris Klosner, Bronx, N.Y., inquires: 1. Will you please give me the constructional details of a loose coupler that will receive wave lengths of 20,000 meters and that can be adjusted without sliders or switches and have two primaries and two secondaries? 2. Is this loose coupler more efficient than a standard type coupler?

A. 1. The primary tubes are both 14 inches long, and 12 inches and 11½ inches in diameter, wound with No. 20 s.s.c. wire. The secondary coils are 13 inches long, by 11 inches and 10½ inches in diameter, wound with No. 24 s.s. wire. The primary coils and secondary coils are connected in series, so that their inductances oppose each other.

A. 2. The 20,000 meter coupler is not as efficient as the standard type for all around work, but the former is by far the most efficient instrument for receiving long wave stations.

A large loose coupler is always more efficient than a small coupler used with a loading coil. Such auxiliary inductances are a source of loss in any event.

Small Tesla Coil.

(527.) Stanley R. Booth, W. Va., asks: 1. Is it possible to operate a small Tesla transformer coil on a ½-inch spark coil and electrolytic interrupter? 2. What would be the dimensions for this Tesla coil? 3. About what length spark could be drawn from such an apparatus?

A. 1. A small Tesla transformer can be operated by a ½-inch spark coil and an electrolytic interrupter on 110 volts, A.C. or D.C.

A. 2. It can be constructed with a primary 3 inches long by 3 inches in diameter and a secondary 6 inches long and 2 inches in diameter. The primary should be wound with No. 18 B. & S. rubber-covered copper wire and the secondary with No. 28 B. & S. copper magnet wire.

A. 3. You would probably be able to obtain 1½ to 2 inch sparks from this coil.

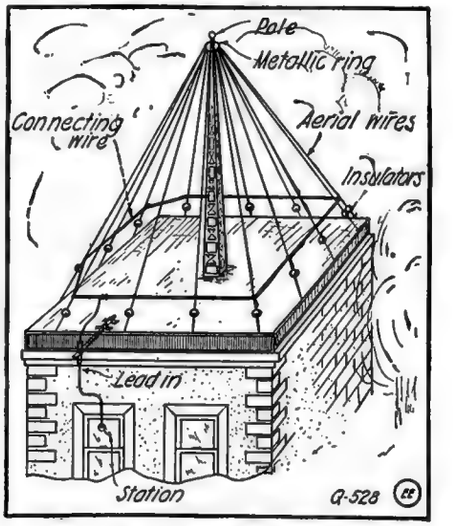
Umbrella Aerial.

(528.) Stanley E. Perezs, Havana, Cuba, writes: 1. What is the wave length of a 3 slide tuner, wound with 365 feet of No. 24 B. & S. bare copper wire? 2. What is the receiving distance of a set with a 3 slide tuner, galena and silicon detectors, two tubular condensers, rotary variable condenser and an umbrella aerial 36 feet high and 36 feet long composed of 12 wires? 3. Which is the most efficient way of connecting an umbrella aerial?

A. 1. The maximum wave length that you can obtain by using this tuner is about 1,200 meters.

A. 2. You should have no trouble in receiving 500 miles.

A. 3. The illustration herewith gives the



Umbrella Aerial Arrangement.

connections of a suitable umbrella type antenna.

(*Continued on page 118*)

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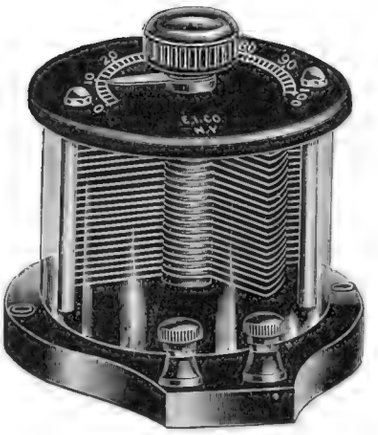
"Electro" Rotary Variable Condensers

Consider these features: **FIRST**—THESE CONDENSERS ARE THE ONLY ONES MADE WITH A TRANSPARENT CASE IN WHICH OIL CAN BE USED WITHOUT IT LEAKING. In this way the Condenser capacity can be increased FIVE TIMES. **SECOND**—THIS CONDENSER IS THE ONLY ONE NOW ON THE MARKET WITH THE CONNECTIONS AT THE BOTTOM. Cover is of highly polished hard rubber composition with a large scale that is easily read. The Condenser has provisions for screwing it down to a table, a really invaluable feature not found in others.



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No. 9240—"Electro" Rotary Variable Condenser, 17 plates, Capacity .0004 m. f., size 4⅛x3⅞ in. Shipping weight 2 lbs. **Price, $2.75**

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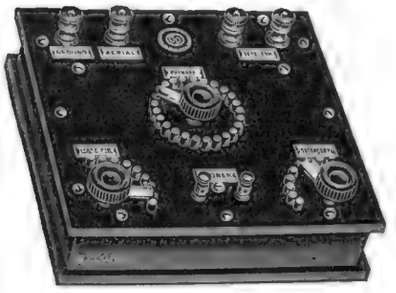

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Smallest and most compact long distance wireless receiving outfit manufactured.

No. 11000—"Electro" Vario Selective Coupler (No phones or detector) Price, $6.50

The "Electro" Loading Coil

To receive messages from stations using long wave lengths it becomes necessary to use a loading coil to increase the natural wave length of the ordinary tuning coil or loose coupler. Our loading coil has a wave length of approximately 5,000 meters.

There are six points, each representing approximately 800 meters wave length, and by simply revolving the knob most any wave length can be obtained. Either a loose coupler or a tuner must be used in conjunction with this instrument.

It is made entirely of hard rubber composition with large hard rubber handle and hard rubber binding posts. All metal parts are nickel plated and highly polished; its size is 4 in. in diameter and 1½ in. in height. Explicit directions and diagrams are furnished. WE GUARANTEE SATISFACTION.

No. 8487—"Electro" Loading Coil, as described. *Shipping weight 1 lb.* **Price, $2.50**

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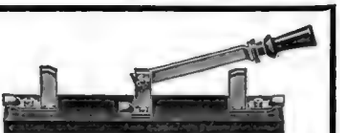

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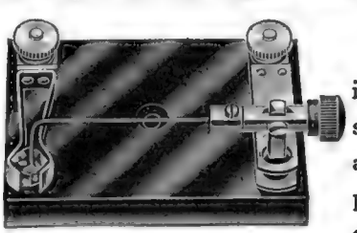

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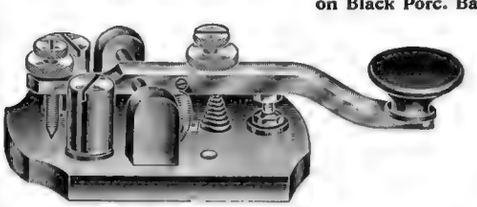


No. 7939. Standard Wireless Key, $2.70

J. H. Bunnell & Co.'s

Radio Dept.

32 Park Place New York

QUESTION BOX.

(*Continued from page 116*)

Dynamo Troubles.

(529.) Eugene S. Bee, Miss., asks: 1. Why will my motor generator not develop current when it runs all right as a motor?

A. 1. We would advise you to excite the generator field from some source of current and at the same time run the machine. If you do not obtain any results after exciting the field in this manner, the only other thing to do is to reverse the field connection. In one of these ways you will no doubt get the machine to develop the proper amount of current, if it is not burned out. Test your armature coils and commutator.

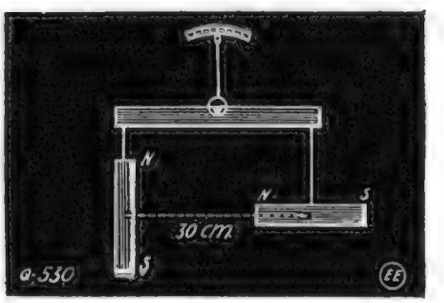
2. Should a ground wire be insulated from the house structure when it is lead to earth? 3. What is the maximum wave length of the receiving transformer which I have described?

A. 2. It is not necessary for you to insulate the ground wire when leading it to the ground terminal; no insulators should be used.

A. 3. About ,500 meters.

A MAGNETIC PROBLEM.

(530.) Jacob Fossauer, Brooklyn, N.Y., wishes us to solve three problems for him.



Will the Attraction Between the Two Magnets Unbalance the Scale Beam?

Q. 1. Two magnets 1 cm. x ½ cm. x 30 cm. long magnetized to an intensity of 700 units pole per square cm. of sectional area are hung from a balance beam as indicated in Fig. 1. Assuming that the magnets exactly balance each other before they are magnetized, find the number of grams which must be added to one pan to balance the magnets after they are magnetized and specify to which pan it must be added.

A. 1. In order to put the pan in equilibrium again, it will be necessary to add .715 grams to the left pan after the magnets have been magnetized.

Q. 2. A horizontal electric light wire stretched due magnetic north and south carries 1,000 amperes of current flowing toward the north. The length of the wire

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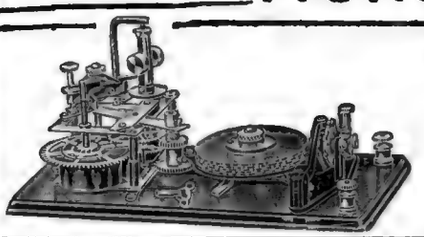

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is 250 meters, the intensity of the earth's field is .57 gauss and the magnetic dip is 63°. Find the value of the force pushing on the wire and specify the direction.

A. 2. In this problem the amount of force pushing on the wire is 1,269,500 dynes and the direction is west.

Q. 3. The choke coil of a lightning arrester consists of 50 turns of wire wound in one layer and on a cylinder of which the diameter is 15 cm. and the length is 50 cm. (a) Calculate the approximate inductance of this coil. (b) Calculate the approximate rate of increase of current in the coil at the instant that a lightning discharge jumps across 2 cm. of air in preference to going through the coil.

A. 3. The inductance of the coil described in the third problem is .000111 henry. The amount of current produced by the lightning discharge at instantaneous value is 360,000,000 amperes.

CHOKE COIL.

(531.) Joseph Spencer, Delaware, wants us to give him the dimensions for building a choke coil for an arc used in radio-telegraphy.

A. 1. It is impossible for us to give you dimensions for a choke coil unless the power of the arc is specified.

Q. 2. Can alternating current be used for a radio arc?

A. 2. Alternating current can be used for a radio arc, providing a step-up transformer is employed.

Q. 3. What are the best materials to use for the arc electrode?

A. 3. Carbon and copper electrodes have been found the best to use in constructing the arc generator.

WAVE-LENGTH.

(532.) Clyde Stewart, Wisconsin, inquires:

Q. 1. Will a helix increase the wave length of a sending station; if so, how much?

A. 1. A helix will increase the wave length of a sending station, but it is impossible to say how much, as it is necessary to know first the size of the helix and aerial used.

Q. 2. Will an arc send as far as a transformer on the same amount of current?

A. 2. An arc will not send as far as a transformer on the same amount of current, unless the arc is supplied with upwards of 2 K.W. of power and even in this case it is hard to say whether the arc will send as far as a transformer of the same rating, but arcs that use power above 50 K.W. will usually send further than transformers of the conventional type.

Q. 3. Will the current from a transformer coil kill a person?

A. 3. Whether such a coil will kill a person depends upon the size of the coil and also the manner in which the person is shocked. Some people will stand shocks much better than others. It also depends upon the physical condition of the person that receives the electric current, moisture of hands, etc.

COIL FORMULAE.

(533.) W. Grimshaw, Akron, Ohio, wants to know the correct formula for determining the wave-length of a specified coil.

A. 1. The formula which you desire is herewith given:

$$W.L. = \frac{\pi\ (3.1416) \times d \times t \times L \times 4}{3.28}$$

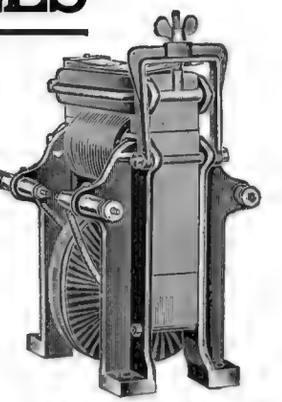
Where:— W.L.=Wave Length in Meters.
d=Diameter of coil in feet.
t=Number of turns of wire per inch.
L=Length of coil in inches.

This result is only approximate.

The wave length of any coil is depend-

(*Continued on page 121*)

YOU CAN "SEND" 1000 MILES



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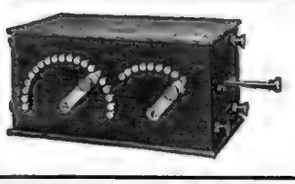

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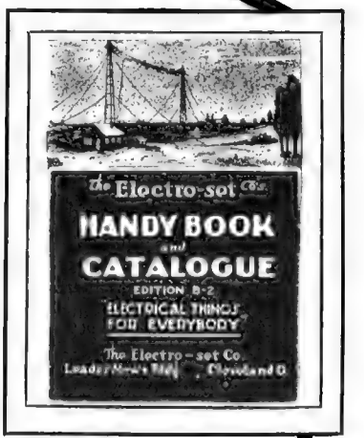

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Formulas for Capacities and Wave Lengths
Code Charts

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QUESTION BOX

(*Continued from page 119*)

ent upon its inductance and (inherent) distributed capacity. The latter is small in most cases and is ignored in figuring these tuning coils as a component of compound oscillating circuits, as for instance, when a coil is connected in series with an aerial. The capacity and inductance of the aerial and lead-in are calculated and to these quantities is added the inductance of the tuning coil.

The inductance of a coil in henries may be found by connecting it up in series with an ammeter on an A.C. circuit. A voltmeter is connected across the coil, and a frequency meter shunts the feed lines. Then, knowing R, the ohmic resistance of the coil; E, the effective volts across the coil; I, the effective current in amperes traversing the coil and F the frequency in cycles per second as indicated on the frequency meter, the inductance L, in henries, is found by the formula:

$$L = \frac{1}{2\pi f}\sqrt{\frac{E^2 - I^2R^2}{I^2}};$$

where $\pi = 3.1416$, a constant.

There is a host of formulae available for calculating the inductance of coils but the majority of them are not accurate for short coils, such as those encountered in radio-telegraphic work. The following formula, due to Brooks and Turner, (*see University of Illinois Bulletin, Vol. IX, No. 10*) will be found useful. This is applicable to coils whose length is but twice the diameter. The value of L is in henries.

$$L = \frac{4\pi^2 \times a^2 \times N^2}{b + c + v} XY \times \frac{1}{10^9};$$

$$X = \frac{5b + 6c + r}{5b + 5c + (.7r)};$$

$$\text{and } Y = \tfrac{1}{2}\log_{10}\left[100 + \frac{14 \times r}{2b + 3c}\right].$$

Where a=mean radius of windings. r=major radius of coil. b=axial length of coil. C=thickness of the winding; all dimensions in centimeters. N is the total number of turns in the windings.

ELECTRIC PROBLEMS.

(534.) B. Goldberg, Brooklyn, N.Y., wishes to know the correct answers to two problems which he has submitted:

Q. 1. Two parallel metal plates each 1 cm. in diameter are placed in pure distilled water, 10 cm. apart, and an electromotive force of 100 volts is connected to the plates. What is the force in dynes with which the plates attract each other, the inductivity of the water being equal to 90.

A. 1. The two plates attract each other with a force of 32×10^{-4} dynes.

Q. 2. The spiral spring of a Siemens electrodynamometer is twisted through an angle of 225° to balance the force acting on the movable coil when a current of 14 amperes flows through the instrument. A twist of 160° is required to balance the force action of current which is being measured by the instrument. What is the required value of current.

A. 2. The answer to your second problem is 11.8 amperes which is the amount of current required to turn the electrodynamometer to an angle of 160°.

COST OF RUNNING COIL.

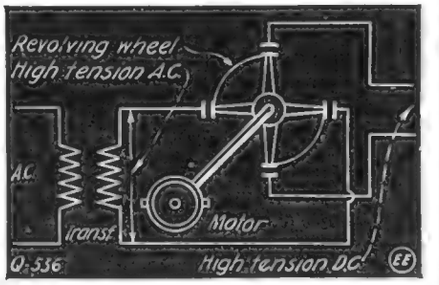
(535.) Q. 1. Myrl Priest, Minnesota, asks:

How much will it cost to run a one-inch coil from an electrolytic interrupter for one hour at the rate of eighteen cents per kilowatt hour.

A. 1. It will cost you about five cents an hour to run the one inch coil with an electrolytic interrupter.

ROTARY RECTIFIER.

(536.) Spyker G. Kurtz, Pennsylvania, wants a diagram showing the construction of a rotary rectifier for high voltage currents.



High Voltage Rectifier for Converting A.C. to D.C.

A. 1. The illustration gives a schematic diagram of such a rectifier.

Q. 2. Please give the length and diameter of both primary and secondary cylinders of the Navy Type receiving transformers.

A. 2. The dimensions of the primary and secondary cylinders of the Navy Type receiving transformers are: primary 5x4½ inches, secondary 5x4 inches.

PASTE FOR STORAGE BATTERY PLATES.

(537.) J. Bottlewood, Englewood, N.J., desires to know:

Q. 1. How is the ampere-hour capacity of a storage battery determined?

A. 1. The ampere hour capacity of a storage battery is determined by multiplying the number of amperes consumed by the instrument which uses the power of the storage battery, and the number of hours that the power is used without recharging. Thus, if a storage battery is rated at 60 ampere-hours, that means that 8 amperes of current can be drawn for 7½ hours or 20 amperes for 3 hours, etc.

Q. 2. What is the paste composed of in the positive and negative plates?

A. 2. The positive plate is coated with a paste composed of lead oxide (red lead) and sulphuric acid which is used to soften the lead oxide. The negative plate is also made of lead oxide (litharge) mixed with sulphuric acid. The pastes of both plates are forced into the pockets under high pressure. During formation of the plates the negative paste becomes converted to spongy lead, while the positive plate is converted into lead peroxide.

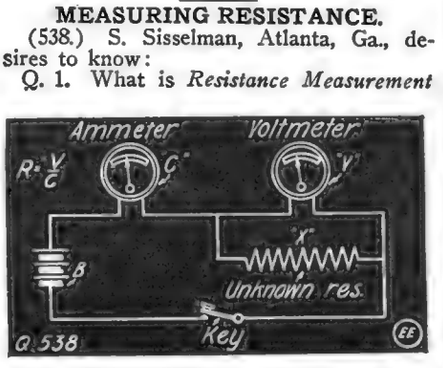
Q. 3. Are "Crowfoot" gravity batteries suitable for charging storage batteries?

A. 3. "Crowfoot" gravity batteries are suitable for charging storage batteries providing a sufficient number of them are used, as the current produced is small.

MEASURING RESISTANCE.

(538.) S. Sisselman, Atlanta, Ga., desires to know:

Q. 1. What is *Resistance Measurement* and how many methods are there whereby unknown resistances can be measured?



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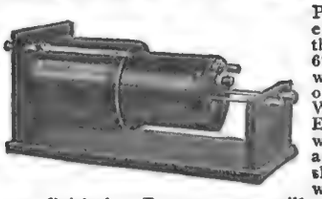

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Closed Core Type Self Contained 14,000 VOLTS 3 Different Powers Shipping Weight—20 lbs.

Folders and information descriptive of these ¼ K. W. transformers may be had for the asking—also of our 500 and 750 watt capacities.

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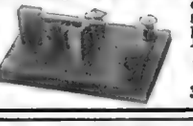
Our New Detector (cat whisker type) is **"Some" Detector**—it is a marvel of simplicity and dependability—base is of **Vulcanized Fibre** and is furnished with **Two** crystal holders—one **Cupholder** and one **Looped Spring** holder—**Post Paid 50c. WINGER ELECTRIC & MFG. CO., 711 So. Dearborn St., Chicago, Ill.**

50c—TELEGRAPH SET—50c

A PRACTICAL LITTLE TELEGRAPH SET

Including key sounder and code chart works with one dry cell. Two sets will telegraph two ways. Price prepaid, 50 cents. Agents wanted. Liberal commission.



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Loose Coupler, $7.50, 1500 Meters

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	Doz.	50	100
Cat. No. 626—¼ inch diameter, ⅜ inch high, tapped 6/32	$.30	$1.00	$1.75
Cat. No. 627—¼ inch diameter, ¼ inch high, ½ inch shank threaded, 6/32.	.36	1.25	2.00
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Prices given above are for plain brass finish; if nickel-plated points are desired add 50 per cent. to the above prices.

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	Each	Doz.
Cat. No. 601—½ inch diameter, 8/32 bushing	$ .04	$ .40
Cat. No. 602—1 inch diameter, 8/32 bushing	.10	1.00
Cat. No. 606—1¼ inch diameter, 13/16 inch high	.20	2.00
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THE "ALBANY" HOT WIRE METER

This hot wire meter was designed especially for the wireless transmission circuits. Has open scale and is finished in nickel with black insulated base. Front connected. It is accurately calibrated and will stand 100 per cent. overload. Over all size 3 inches by 2⅝ inches by 1¼ inches. Shipping weight 2 lbs.

Cat. No. 339—Range 0 to 3 Amperes	$3.50
Cat. No. 340—Range 0 to 5 Amperes	3.75

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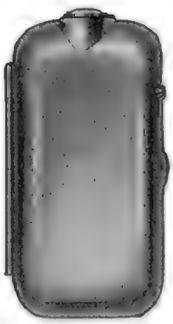
Beacon Flash-lights and **Batteries** are made in a wide variety of styles and shapes but only one quality—**THE BEST.**


"Cigarette"

"Ideal Fountain Light."

"Short-Circuit Proof."

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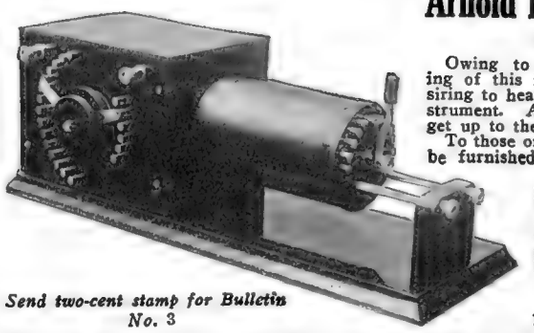
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Arnold Navy Type Loose Coupler

PRICE, $15.00

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To those ordering an instrument such Hook-up will be furnished gratis.

It is as in the past the Right instrument to do all first class receiving with. Workmanship and material the best.

Send 2-cent stamp for Bulletin No. 3, which describes fully, also shows the finest line of Switch points, Rubber knobs and accessories on the Market.

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A. 1. Resistance is that which offers opposition to the flow of electricity. Ohm's law shows that the current strength falls off in proportion to the increase in resistance. This gives a basis for measuring resistance. There are various methods by which unknown resistance may be measured as by the:

(1) Direct Deflection method,
(2) Method of substitution,
(3) Fall of potential method,
(4) Differential galvanometer method,
(5) Drop method,
(6) Voltmeter method,
(7) Wheatstone bridge.

Q. 2. Give a diagram for measuring the resistance of a coil by using the fall of potential method?

A. 2. The diagram herewith shows the connections of the instruments used. The resistance of the voltmeter should be very high, if accurate results are to be obtained.

Q. 3. What is a *ballistic galvanometer?*

A. 3. A ballistic galvanometer is an ordinary type galvanometer, but it is designed to measure the strength of momentary currents, such for instance as the discharge of a condenser. In construction, the magnetic system is given considerable weight, and arranged to give the least possible damping.

FLICKERING OF LIGHTS.

(539.) William H. Mansfield, Jr., wants to know:

Q. 1. What instrument can be used for preventing the lights from flickering when a transformer is in operation?

A. 1. The only device that you can use successfully to reduce the flickering of the lights is a choke coil.

Q. 2. What is the wave length of an aerial 144 feet long, 60 feet high with a 50 foot lead-in?

A. 2. The natural wave length of your antenna is about 400 meters.

EDDY CURRENT LOSSES.

(540.) J. Johnston, Brooklyn, N.Y., asks;

Q. 1. Explain what the copper losses are in building transformers.

A. 1. The copper losses are the sum of the I^2R losses of both the primary and secondary windings and the eddy current loss in the conductors.

Q. 2. Is the eddy current loss in the conductors large?

A. 2. The eddy current loss in the conductors is very small and may be disregarded, so that the sum of the I^2R losses of primary and secondary can be taken as the total copper loss for all practical purposes.

Q. 3. What is the special objection to oil in transformer construction and what kind of oil is utilized in transformers used commercially.

A. 3. The main objection to oil for transformer use is the danger of fire. Transformers that use oil, employ a mineral oil as it is less liable to catch fire.

GUN POWDER.

(541.) Troy Huffington, Texas, wants to know:

Q. 1. The chemicals and quantities used in making gun powder.

A. 1. Gunpowder is made by carefully mixing 75 parts of potassium chlorate ($K Cl O_3$), 15 parts of charcoal and 10 parts of sulphur. The materials used should be pulverized.

Q. 2. What is the wave length of my aerial which is 112 feet long and composed of two wires 50 feet high?

A. 2. The wave length of your antenna is 300 meters.

ELECTROLYTIC PROBLEM.

(542.) E. H. Noble, Del., wishes to find

Highest Award Gold Medal San Francisco Exposition

Your Washing Done for 2c a Week

Electric or Water Power Will Do the Work

I have built a new "1900" power washing machine. I consider this machine the most wonderful washer ever put on the market. Tub built entirely of high quality sheet copper, it is the strongest and most durable machine made. It is constructed on a brand new principle and I will guarantee that this machine will not tear clothes, break buttons or fray the edges of the most delicate fabric. It will wash everything from heavy blankets to the finest lace without damage to the goods.

This new "1900" washing machine can be connected with any electric socket instantly and is started and stopped by a "little twist of the wrist" and it will do your washing for 2 cents a week.

I also make a lighter power machine which can be run by water or electric power. On most of these machines the motor will run the wringer too. Just feed in the clothes and this power wringer will squeeze the water out so quickly and easily you will be astonished. It will save 50% time, money and labor every week. The outfit consists of washer and wringer and either electric or water motor, as you prefer, and I guarantee the perfect working of each.

I will send my machine on 30 days' free trial. You do not need to pay a penny until you are satisfied this washer will do what I say it will. Write today for illustrated catalog. Address: H. L. Barker, 6284 Court St., Binghamton, N. Y., or, if you live in Canada, write to the Canadian "1900" Washer Co., 355 Yonge St., Toronto, Canada.

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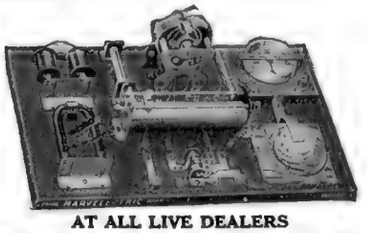

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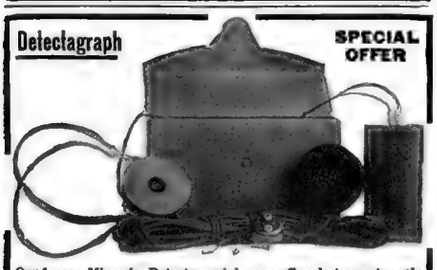
Detectagraph **SPECIAL OFFER**



Our famous Micropho-Detectagraph is now offered at an extremely low price. This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter and connector, 25-ft. Black Cord, Receiver, Headband, Case and Battery. The Transmitter weighs only two ounces. Price complete $12.00 for a limited number only.

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Makers of Detecting Apparatus from $12.00 to $250.00

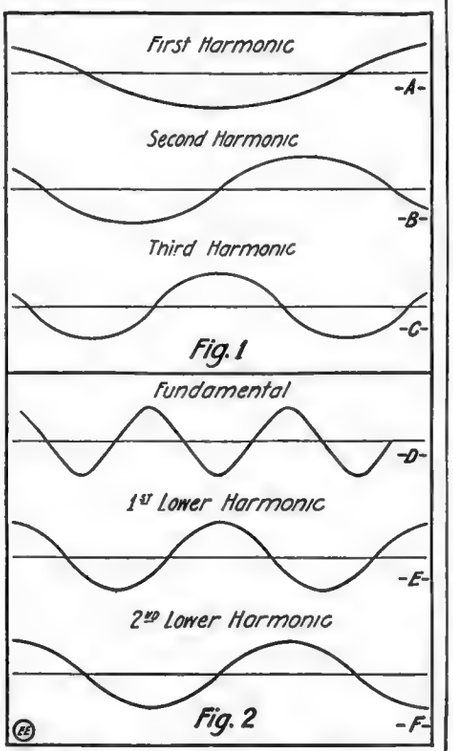
out how many watts of electricity will be required to decompose 1 cubic inch of water in five minutes.

A. 1. The number of watts of electricity that will be required to decompose 1 cubic inch of water in five minutes would be 11.9 watts.

OSCILLATION HARMONICS.

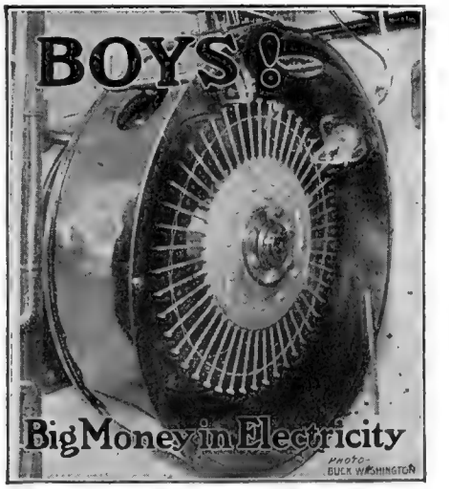
(543.) F. M. Gaston, Memphis, Tenn. asks several questions regarding harmonics of radio waves, and the manner of tuning in such wave length multiples and submultiples?

A. 1. The upper harmonics of a fundamental wave are shown graphically at Fig. 1. At A is observed the first upper harmonic of a fundamental wave having a frequency N; the frequency of the first harmonic is equivalent to 2xN. The frequency of the second harmonic (B, Fig. 1) is 3xN, and of the third harmonic (C, Fig. 1) 4xN. Radio stations are often heard on an upper harmonic For instance, a station transmitting on a 2,500 meter fundamental wave can usually be heard on the first upper harmonic or on a wave



Relation of Various Harmonics and Fundamental Waves

length of half this value. Sometimes the second or third harmonic may be so prominent as to enable a station tuning in at still lower wave lengths corresponding to these upper harmonic frequencies. It has been found in practise that the fundamental wave length is the strongest, however, all things considered. At Fig. 2, is illustrated graphically the appearance of the fundamental (D), first lower harmonic (E) and second lower harmonic (F). Considering the fundamental wave (D) frequency as N, then the first lower harmonic will have a frequency of ½xN; the second lower harmonic has a frequency of ⅓xN, etc. The wave length will change in proportion, i.e., the 2,500 meter wave aforementioned would be heard on the first (lower) harmonic, tuned in to 5,000 meters, this wave length corresponding to a frequency of ½xN, N being the fundamental. The third lower harmonic would have a frequency of ¼xN, and a wave length value of four times the fundamental.



Rotary Spark Gap, Arlington (NAA) Radio Station

THE electrical industries offer wonderful opportunities to boys with a liking for electricity. The salaries paid to trained men are large, promotion comes rapidly, and, best of all, the work is fascinating.

The discovery and development of new lines, such as wireless telegraphy and telephony, from time to time, promise attractive and paying fields to those who wish to specialize. The *will to do* and *Special Training* will bring success to you.

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After securing the money send us the cash or Money Order and be sure that the envelope and letter are plainly marked "*Subscription Contest.*" You will be credited with every subscription you send in. A one year's subscription counts for one point, a two years' subscription for two points, and so on. You may subscribe for three or five years yourself by sending in three or five dollars. In that case you will be credited with three or five subscriptions as the case may be.

The individual sending in the largest number of subscriptions between now and closing date will be entitled to the free excursion to New York as described above, or one of the other prizes we mention below.

RULES

1st. All subscriptions must be sent to us within twenty-four hours after receipt of money.
2nd. The full subscription price—$1.00 in United States, $1.50 in Canada and foreign countries—must be remitted.
3rd. To win the first prize (Excursion to New York) not less than fifty subscriptions must have been sent in.
4th. Anyone, either sex, if over 12 years old, may participate in the contest.
5th. Contest closes at 12 o'clock noon, June 30th, 1916, at which time the last subscription must be in our hands. The winner will be notified at once.
6th. Winners will be announced in our August issue.
7th. Subscription agencies are not eligible to compete.
8th. If two or more persons are tied for any prize each will receive the prize tied for.

ADDITIONAL PRIZES

2nd Prize. A $50.00 Wireless Outfit (Sending and Receiving).
3rd " A $20.00 twenty-year guarantee, 17-jewel gold watch.
4th Prize. A $12.00 "Ingento" 2¼ x 3¼ folding camera.
5th " A $10.00 ten-year guarantee, 7-jewel, gold-filled watch.

IMPORTANT! Anyone not winning a prize and sending in more than 5 subscriptions will be paid a commission of 20 cents on each new subscription he sends in. Commissions will be paid at the close of the contest.

Someone is going to win each of the prizes. Will it be you? If you believe in yourself and in the ELECTRICAL EXPERIMENTER, you will succeed. Better start right now and convince yourself how easy it is in these prosperous times to get subscriptions for a worthy magazine. Address all letters

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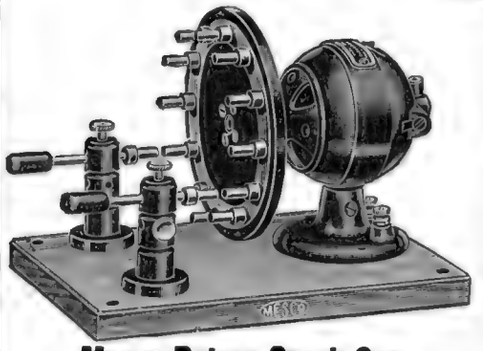

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Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

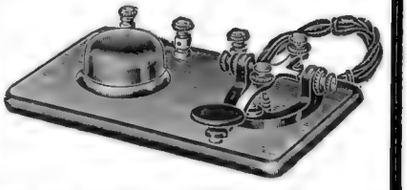
Our Globe Motor is used. Will operate on 110 A. C. or D. C. circuits: speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

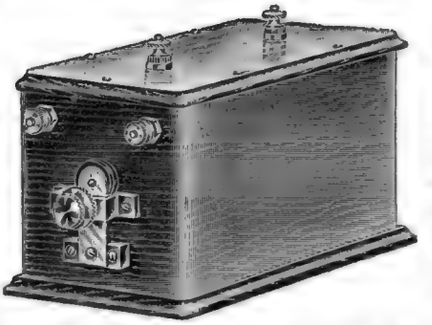
List No.		Price.
222	Mesco Rotary Spark Gap, 6 volt	$12.00
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit Only, with two Stationary Electrodes for 3/16 inch shaft	5.00

Mesco Wireless Practice Set

Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

List No.		Price.
342	Wireless Practice Set, with battery and cord	$1.88





Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case. Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum; spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	Spark Coil, 1 inch; can be operated on 6 Red Seal dry batteries	$5.40

No advance in price of coils yet, although price of material is higher.

17 Park Place - - - New York
114 S. 5th Avenue - - Chicago

MANHATTAN ELECTRICAL SUPPLY CO.

1106 Pine Street - - St. Louis
604 Mission St., San Francisco

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

TIDAL MOTOR.

(68.) John Dougherty, of Cairo, Ill., submits several sketches and description of a Tidal Motor asking us to examine same carefully and advise as to its practicability and whether it will work as described. Also if there is a demand for such a Tidal Motor.

This scheme is not a new one and has been exploited before both theoretically and practically. The trouble with this scheme is that it requires a difference of thirty feet of the sea level before tide and after tide. To our knowledge this does not exist anywhere or under any condition where there would be such a large difference, it being very unusual to have even a difference of ten feet in the level of the water before and after tide. For this reason this scheme, as well as similar ones intended to fill tanks with water and to use the energy thereof after the tide has gone out, have never been proved very satisfactory. We do not say that in the future such a scheme may not be evolved whereby to utilize a small amount of difference in the tide levels, but so far nothing has appeared that is of a practical nature.

AUTOMATIC TELEGRAPH TRANSMITTER.

(69.) Leo Shapiro and Sidney Klein, of Chicago, Ill., state that they are the inventors of an automatic telegraph transmitter which is capable of transmitting telegraph or wireless telegraph messages in either the Continental, Morse or Navy code. Transmitting is claimed to be affected at any rate of speed or from five to twenty words a minute. The machine is supposed to be operated by any one, by simply pressing down various keys. The inventors ask for our advice as to the patentability, etc., of this invention.

There are a great many automatic transmitters on the market now and any textbook on electricity will show what has been done. Without having seen drawings or models of the actual apparatus, it is impossible to say what can or cannot be expected from such a machine. As a rule, however, we would say that such machines are rather expensive and there is not much demand for them on account of this. If there could be evolved a machine that could sell at between $5.00 and $10.00, we think there would be a very good market for same.

COPYRIGHTING INVENTIONS.

(70.) E. Lennert, New York City, writ us as follows:

"Could not you, through your valuable journal, encourage a movement to have inventions registered at the same fee as a copyright, in order to give the inventor time to secure capital for a patent. I had the same idea for a telephone as that shown on page 684, of the April number of *The Electrical Experimenter.* If this registration law had been in use I could have proved priority and could have secured capital to apply for a patent. I believe the majority of inventors hesitate to invest money for a patent before they have expert advice. Will you kindly advise me as to this?"

This letter, one of many, is a strange delusion which many inventors are subject to. Up to a few years ago, the United States Patent Office accepted a Caveat which simply was a registration on a patent before the idea was entirely developed. It was thought that a Caveat would protect the inventor and would assure him a priority claim for his idea. However, very few persons made use of the Caveats and for this reason Congress abolished them and the Patent Office now refuses to accept applications for Caveats and inventors must therefore file a regular application for patent. This was a wise movement for the reason that it has been found that Caveats were not necessary, as the following will explain:—

Suppose you make a certain invention, or suppose you have an idea that you think is absolutely new; you have not, however, the money at the present time to make certain researches in order to complete the work, making models, etc. The simplest thing in this case is to write the invention down as carefully as possible embodying on the same sheet all illustrations so that anyone reading the matter will understand what the invention consists of. Take this sheet to a Notary Public whom you can trust, and have him affix the date and seal upon the sheet; or, if you do not wish to do this, ask several friends to sign their names on the sheet, being sure that the date appears thereon. Once you have this evidence it is practically as good as if you had a patent applied for. If somebody else applies for a patent afterwards and you can show to the satisfaction of the Patent Office that the date of your invention is prior to the one which might have been patented afterwards, the latter patent will be declared void for the reason that you could prove that you were first on the ground.

In any patent issue the most important point is always centered around the fact:

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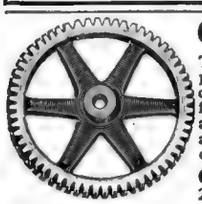

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SPARK LENGTH.

(71.) L. H.S. seeks advice on the following:

He has an idea that by putting a spark coil inside of a closed vessel and exerting a large pressure, as for instance eight atmospheres inside of the chamber that the sparking at the vibrator contacts would be eliminated. In turn the secondary spark length would be increased.

We do not quite agree with our correspondent on this point as we are quite sure that a spark length would be decreased instead of increased, for the simple reason that the vibrator in the compressed air would not swing as rapidly as in the normal atmosphere. As a matter of fact, it has been proved that by putting the sparking contacts in a vacuum enormously larger sparks can be obtained from the secondary, for the reason that the vibrator will swing faster as it is not damped by the air any longer. However, schemes of this kind are not eminently feasible for everyday use as they are too costly for the small benefit which they give.

EXPANDING MIXTURES.

(72.) Sterling Waggoner, Putney, So. Dak., claims to have devised a mixture which expands slowly, but powerfully, when a small amount of battery current is passed through it. He would like to know if such an invention is of any use; what its uses are and if it is patentable. He furthermore gives us a description of the invention explaining how it acts.

Without knowing the entire details we are at a loss to know whether the invention is new or not. There are many bodies which, when a current is passed through, will expand; for instance a solution of common salt water, when current is passed through it, will generate gas which will expand in direct proportion to the amount of current used. Of course, this is not expanding the water, itself, but it does it indirectly. Metals will also expand directly when a current is put through which heats up the metal. Offhand, we do not know of any use for an expanding mixture of the kind described by our correspondent, as it depends entirely how it can be used, whether it is liquid, semi-liquid, or solid in form. We would advise our correspondent to get in touch with a patent attorney.

PERISCOPE.

(73.) Clyde B. Marx, Kaskela, Oregon, submits two inventions; one, a spring-barb fish hook, the other a four-sided periscope. He desires to have our opinion on the two inventions.

In the fish hooks shown, we see nothing new and are quite sure that hooks of this kind are now in use. We see no improvement over others on the market now.

On the four-sided periscope which our correspondent has devised in order to see in four directions at the same time, very similar devices as this are in use by most of the Navies now. Most of the new periscopes make it possible to see all around the horizon; in other words, they cover 180 degrees at one glance.

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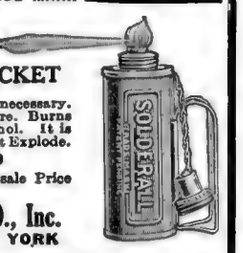

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Book Review

EXPERIMENTAL PHYSICS. By Harold A. Wilson, M.A., D.Sc., F.R.S. 406 pages; 75 illustrations; 6x8½ inches. Cloth bound. Price, $2.50. Cambridge University Press. Supplied by G. P. Putnam's Sons, New York.

A treatise intended for use by students of the subject and also of particular worth to the general reader. The topics treated include: Laws of Motion and Matter, Mechanics of Rigid Bodies, Properties of Liquids and Gases, Convection and Conduction, Heat a Form of Energy, Wave Motion, Musical Notes, Interference of Sound Waves, Vibration of Air in Open and Closed Pipes, Lenses, Optical Instruments, The Velocity of Light, Interference and Diffraction, Energy of Light, Invisible Radiations, et cetera.

The method of explanation involved is very commendable and brings out the salient points of many physical problems heretofore but vaguely expatiated upon by most text book writers. The chapters on light and sound are particularly well prepared. The action of wind or air in organ and other pipes provided with "stops," etc., are covered in a simple, yet thoro and scientific manner, without the use of higher mathematics. The section on sound and the component elements making up stringed instruments is of extreme interest to all students of physics. The exact reason why any piano can never produce absolutely pure music, owing to the odd divisions of the scale employed, is elucidated clearly, and conversely the reason why the violin is capable of yielding the purest music, a fact long known among expert musicians, but practically never treated upon in such works as this Simple methods of determining and measuring sound vibration frequency are offered as well as schemes for causing tuning forks to vibrate continuously. Professor Wilson has succeeded in writing a book on pure science which does not tire the reader with unnecessary facts of little or no practical value. Some of the chapters might have been elaborated upon to a greater extent it seems, but the topics embraced and their treatment more than compensate for those subjects not included.

ELECTRIC LIGHT FITTING. By S. C. Batstone, A.M.I.E.E. 317 pages, 238 illustrations; 7½x5 inches. Cloth bound. Price, $1.50. 1914 (new edition), Macmillan Co., New York.

This book is very helpful for those interested in the installation of wiring for lights, heaters, stoves and other electric appliances in the home. Although written by an Englishman on English standard fittings, the instructions are quite applicable to American work. The book contains valuable information on the use of conductors, casings, conduits and cleats. It gives a complete explanation of the methods used in installing switches, cutouts, distribution boards and lighting fixtures. The chapter on house wiring, augmented by diagrams showing the best location for fixtures, is interesting to electricians and prospective home builders. In connection with this chapter is one on direct and indirect lighting. The latter part of the book explains the installation of private electric plants. Since Mr. Batstone is an authority on the methods of electric wiring, his book should prove helpful to those interested in the subject.

EXPERIMENTAL WIRELESS STATIONS, 1916 EDITION. By Philip Edelman. 269 pages; 100 illustrations; 5½x8 inches. Cloth bound. Price, $1.50. Published by the Author, Minneapolis, Minn.

Any amateur wireless operator who wishes to learn more about the principles upon which his set works, will do well to read this book. While Mr. Edelman does not touch upon the newly developed instruments, except in the supplement, he gives clear instructions for making simple and efficient radio apparatus. Those who have read the current publications will not learn much from this book. However, it is to be highly recommended to those who are only beginning to feel an interest in radio work. The illustrations could be clearer for they are rather small line cuts and the quality of paper used does not help to bring them out very clearly.

In the supplement some of the latest discoveries are disposed of in a single paragraph. A full explanation of the weather reports, with the Beaufort scale of wind velocity is given. For those interested in patenting wireless apparatus, the patents covering this field are listed complete. This book, now in its third edition, has been well received by amateurs who want a non-technical book on the operation and construction of radio apparatus.

INVENTIONS AND PATENTS. By Philip E. Edelman. 288 pages; 5½x8 inches. Cloth bound. Price, $1.50. Published by D. Van Nostrand Co., New York City, N.Y.

Previous books by this writer have found a ready demand among experimenters and in the present volume he turns to the protection of ideas or inventions the experimenter may make and has covered the subject in a very clear manner that will be of great service to budding patentees.

The matter is not fogged with rulings and laws but endeavors to explain the requirements of a strong and valid patent. The many suggestions given in this volume will enable the inventor to get a clear grasp on the main points of his invention and he will thus be in a position to present claims that give full protection from infringement. Patent Office routine and other features are incorporated in the work.

The development of the patent system, the Patent Office, attorneys, field of invention, patent preparation, application, protection, rights, disposition and infringement are some of the subjects covered. Points on foreign patents and the present status of inventions are also dealt with. A novel idea in the makeup of the book is a number of memoranda pages for the convenience of the reader of the treatise. The appendix quotes many decisions from patent suits which will enable anyone to form an opinion on pending suits in which they may be interested. On the whole the book is worthy of a place in the inventor's library.

INJURIOUS EFFECTS OF ELECTRIC SPARK UPON THE EYE.

Although the ultra-violet rays have not any practical application to radio as yet, they have been found quite injurious to the operator who is constantly viewing the spark gap. If these rays constantly act upon the eye, they produce a troublesome irritation known as conjunctivitis.

The conjunctiva is the mucous membrane that lines the inner surface of the eyelids and covers the front of the eyeball, thus connecting the lids and the eye itself. In conjunctivitis the conjunctiva is inflamed and eyelid becomes swollen, red, partially shut and usually quite painful.

A cinder in the eye or a bruise may cause this. It may be interesting to note that the phrase "something in the eye" is not quite correct. Foreign substances do not lodge in the eyeball, as usually thought, but in the conjunctiva membrane lining the eyelid lid.

But to return to the subject. Ultra-violet rays and the sharp violet tone of a spark gap irritate, the conjunctiva and sometimes cause it to become inflamed.

To prevent this trouble wear smoked glasses when working around the spark and use the eyes as little as possible; also bathe them with an eye wash, such as a dilute solution of boracic acid. Conjunctivitis, though not usually acute, may become quite chronic unless cared for properly. The best method of overcoming the injurious effect occasioned by the spark gap is to place this instrument in a case containing a small opening covered with cobalt glass; this is used for observing the working conditions of the gap and at the same time it will prevent the harmful ultra-violet rays developed from striking the eye and thus the dangerous effects which have been mentioned, will be eliminated.

WIRELESS SUIT DISMISSED.

The wireless patent infringement suit brought by Samuel M. Kintner and Halsey M. Barnett, receivers of the National Electric Signal Co., against the Atlantic Communication Co., which operated the Sayville wireless station, was dismissed on Jan. 7 by Judge Mayer in New York. It was complained that the defendant had infringed two claims of a patent granted in April, 1909, to Reginald A. Fessenden, and four claims of another patent which applied to the manufacture of wireless apparatus.

The musical note emitted in using the wireless was one of the points upon which it was claimed that the Fessenden patent had been violated; but Judge Mayer pointed out that he could not hold that Fessenden had been the original discoverer of its value. While he was working out his idea, De Forest was actually operating commercial stations with it, and was, moreover, working at the method in his own way.

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GOVERNMENT RADIO CORRECTION NOTICE.

Capt. W. H. G. Bullard, Superintendent of the U.S. Naval Radio Service, has brought to our attention an incorrect statement made in our March issue relative to the telegraph circuits to Alaska. He states:

"That in addition to the cables operated by the Washington-Alaska Military Cable System from Seattle to various points in Alaska, and the route via Vancouver, the United States Naval Radio Service maintains a chain of shore stations in Alaska, the connecting point in the United States being at North Head, Wash., for traffic other than California points, and Eureka, Cal., for California points. The North Head and Eureka stations are connected with the telegraph service in the United States and traffic agreements entered into. The Naval Radio Service is also connected with the Washington-Alaska Military Cable System in order to fill in all gaps in their circuit due to interruptions to cable service. Whenever the service of the Military Cable System is interrupted between Sitka and Seattle, messages are sent via North Head without additional charge.

The Marconi station at Astoria referred to in the original article (page 621) is connected with Ketchikan and Juneau."

In the same issue, on page 613, there is a statement which Capt. Bullard would like us to correct as follows:

"The United States Naval Radio Service maintains fifty-three stations. The chain of shore stations covers the Atlantic, Gulf and Pacific Coasts as well as the coast of Alaska. There are also Naval Radio stations in the Philippines, Guam, American Samoa, Honolulu, Cuba and Porto Rico. A large number of the stations are open to commercial business, while the high power stations at Arlington and Darien are used for Government traffic between the Panama Canal and Government departments. Other high power stations are in course of erection. In addition to the regular stations of the Naval Radio Service mentioned before, this service has charge of the operation of the high power stations at Sayville and Tuckerton, which are operated for the owners."

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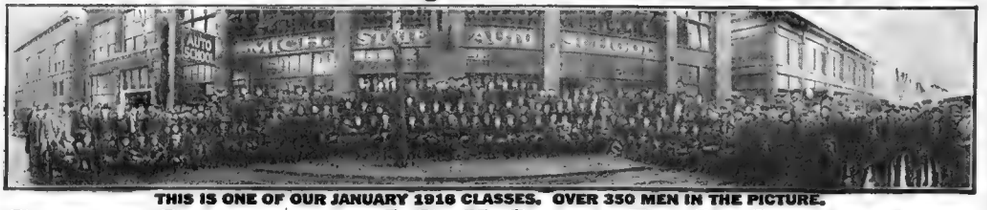

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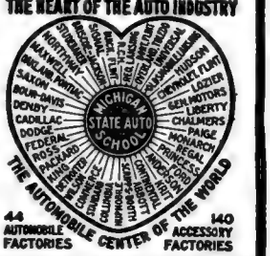

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The Old Reliable School
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AN ELECTRICAL RADIATION PYROMETER.

A new electrical radiation pyrometer is described by S. L. Brown in the *Physical Review.* The plan in this instrument is to replace the thermo-junction of the Féry radiation pyrometer with an oxide resistance element. The radiation from the hot body whose temperature is to be measured is focused, by means of a concave mirror, on a very small and thin oxide element. This element is connected in series with a constant-voltage battery and a high-resistance millivoltmeter. The current, as indicated by the deflection of the millivoltmeter, is a measure of the temperature of the body whose radiation is focused on the high-resistance oxide element. The instrument may be adapted to any temperature interval by shunting the millivoltmeter with the proper resistance. For example, a temperature change from 1600 deg. to 2100 deg. Fahr. may cause a deflection of the millivoltmeter from 50 to 125 with a particular shunt, while this same district of the millivoltmeter scale may correspond to temperatures below 1600 deg. Fahr. when a higher resistance shunt is used.

ELECTRICITY VERSUS STEAM FOR RAILROADS.

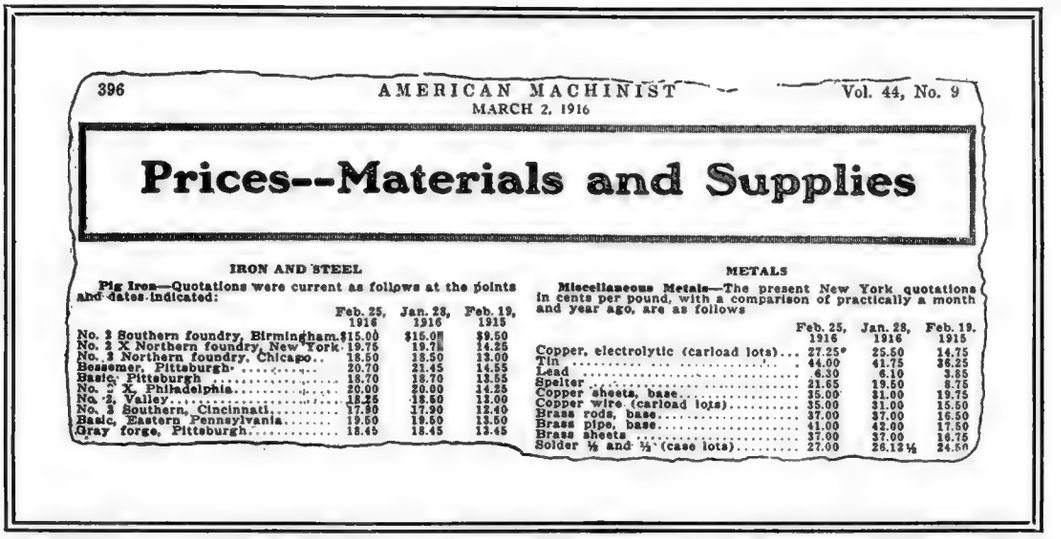
Over 2,000 miles of the railroad lines of this country are now operated by electricity. In recent tests between steam and electric traction with the same load of freight up a 2 per cent. grade, the electric locomotive had an average speed of 15 miles per hour as against 7 miles for the steam engine.

Electricity for railroads means the elimination of all smoke, ashes, and not by any means last—the incessant noise of its steam prototype.

TO THE PUBLIC

WE, the undersigned, wish to announce that, due to conditions over which we have no control, it has become necessary for us to advance our prices on certain items listed in our Catalogs.

By referring to the clipping from the *"American Machinist"* below—



396 AMERICAN MACHINIST Vol. 44, No. 9
MARCH 2, 1916

Prices--Materials and Supplies

IRON AND STEEL

Pig Iron—Quotations were current as follows at the points and dates indicated:

	Feb. 25, 1916	Jan. 28, 1916	Feb. 19, 1915
No. 2 Southern foundry, Birmingham	$15.00	$15.00	$9.50
No. 2 X Northern foundry, New York	19.75	19.75	14.25
No. 2 Northern foundry, Chicago	18.50	18.50	13.00
Bessemer, Pittsburgh	20.70	21.45	14.55
Basic, Pittsburgh	18.70	18.70	13.55
No. 2 X, Philadelphia	20.00	20.00	14.25
No. 2, Valley	18.25	18.50	13.00
No. 2 Southern, Cincinnati	17.90	17.90	12.40
Basic, Eastern Pennsylvania	19.50	19.50	13.50
Gray forge, Pittsburgh	18.45	18.45	13.45

METALS

Miscellaneous Metals—The present New York quotations in cents per pound, with a comparison of practically a month and year ago, are as follows

	Feb. 25, 1916	Jan. 28, 1916	Feb. 19, 1915
Copper, electrolytic (carload lots)	27.25*	25.50	14.75
Tin	44.00	41.75	36.25
Lead	6.30	6.10	3.85
Spelter	21.65	19.50	8.75
Copper sheets, base	35.00	31.00	19.75
Copper wire (carload lots)	35.00	31.00	15.50
Brass rods, base	37.00	37.00	16.50
Brass pipe, base	41.00	42.00	17.50
Brass sheets	37.00	37.00	16.75
Solder ½ and ⅝ (case lots)	27.00	26.12½	24.50

an authority on the metal market,—it becomes apparent that it is absolutely impossible to continue selling certain goods at our former price. Brass and copper which enter largely into our products have increased over 100% during one year and are rising steadily, due to the extraordinary conditions occasioned by the European war. Not only the metals but nearly *every* raw material on the market has increased from 25% to 200%. It is earnestly hoped that the Public will understand and appreciate the situation. We give our assurance that just as soon as conditions become normal again, our prices will be brought to their former levels and even lower if possible.

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C. Brandes Inc.
Clapp Eastham Co.
Wm. B. Duck Co.
Electro Importing Co.
La Salle Light Co.
Maguire & Shotton
Mignon Wireless Corporation
Smith & Hemenway
E. T. Turney Co., Inc.

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Get Started Now

FREE Outfit
Write now for special literature and prices on 5 courses—terms, testimonials, sample lesson and Free Outfit offer. ALL FREE—Don't delay, act quickly.

Guarantee
I guarantee to place competent graduates at $85.00 to $175.00 monthly. The demand for trained competent men is far greater than the supply.

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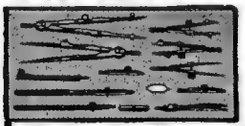

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STANDARD RADIO TERMS DEFINED.

Approved by the Institute of Radio Engineers.

Under this head we will define the most important radio terms each month. Save them and by pasting each in a book (properly indexed) you will have a handy radio dictionary.

21. *Brush or Coronal Losses:* Those due to leakage convection electric currents thru a gaseous medium.

22. *Cage Conductor:* A group of parallel wires arranged as the elements of a long cylinder.

Note: Any conducting element of an antenna may be a cage conductor.

23. *Capacity, Effective, of an Antenna:* The effective capacity and effective inductance of an antenna at any oscillation frequency are the equivalent capacity and inductance values determined from the following fundamental equations:

$$\omega = \sqrt{\frac{1}{LC}} \quad \cdots\cdots \quad (1)$$

where L=the total antenna inductance,
C=the total antenna capacity,
ω=the angular velocity of the free alternating currents in the antenna.

$$d = \pi R \sqrt{\frac{C}{L}} \quad \cdots\cdots \quad (2)$$

or $$d' = \pi R' \sqrt{\frac{C}{L}} \quad \cdots\cdots \quad (2a)$$

where R'=series resistance inserted at the base of the antenna and
d'=increased decrement resulting therefrom

Solving (1) and (2a) for L and C, we have

$$L = \frac{\pi R'}{\omega d'} = \frac{R'}{6\times10^8\times d'} \cdot \lambda \quad (\lambda \text{ in meters})$$

$$C = \frac{d'}{R'} = \frac{d'}{6\pi^2\times10^8\times R'} \cdot \lambda \quad (\lambda \text{ in meters})$$

Having the antenna inductance and capacity, the resistance R of the antenna can be determined from equation (2). This value of R satisfies the fundamental equation:

RI^2=power absorbed by the antenna,
where I=current measured at the base of the antenna.

Note: The equation

$$I = \omega CE$$

and also $$E = \frac{\pi R'}{d'} \cdot I$$

defines an effective voltage E, which is the voltage approximately given by the equation,

Energy per spark$=CE^2$.

24. *Center of Capacity of an Antenna:* See Form Factor, Note 2.

25. *Changer, Frequency:* A device delivering alternating currents at a frequency which is some multiple of frequency of the supply current.

26. *Changer, Wave:* A transmitting device for rapidly and positively changing the wave length.

27. *Characteristic, Dynamic, of a Conductor:* (For a given frequency and between given extremes of impressed E.M.F. and resultant current thru the conductor): This is the relation given by the curve obtained when the impressed E.M.F.'s are plotted as ordinates against the resultant currents as abscissas, both E.M.F.'s and currents varying at the given frequency and between the given extremes.

28. *Characteristic, Static, of a Conductor:* This is the relation given by the curve plotted between the impressed electromotive force as ordinates and the resultant current thru the conductor as abscissas for substantially stationary conditions.

29. *Coefficient, Attenuation, Radio:* See Attenuation.

30. *Coefficient of Amplification:* See Amplification.

31. *Coefficient of Coupling, Inductive:* The ratio of the effective mutual inductance of two circuits to the square root of the product of the effective self inductances of each of these circuits.

32. *Coherer:* A device sensitive to radio frequency energy, and characterized by (1) a normally high resistance to currents at low voltages, (2) a reduction in resistance on the application of an increasing electromotive force, this reduction persisting until eliminated by the application of a restoring or disturbing mechanical force, and (3) the substantial absence of thermo-electric or rectifying action.

33. *Communication, Radio:* The transmission of signals by means of electromagnetic waves originating in a constructed circuit.

34. *Compass, Radio:* A radio receiving device for determining the direction (or the direction and its opposite) in which maximum energy is received; or

A radio transmitting device for determining the direction (or the direction and its opposite) of maximum radiation.

(*To be continued*)

THE MARVELS OF MODERN PHYSICS.

(*Continued from page 96*)

this will produce a curve or kink in the line, which travels outward, or at right angles to the direction of motion of the electron. This again is the electro-magnetic wave and as the lines of force extend in all directions, it too travels in all directions. The electron vibrating in the molecule generates such disturbances and when this motion is increased sufficiently by heating, we perceive the direct results as light. All rays, no matter whether they are the short gamma rays or the long Hertzian waves, most probably originate in this manner. The different means of producing the latter in wireless work are only methods of producing the above effects on a larger scale. Consider a simple antenna consisting of a single vertical wire as shown in Fig. 6. The spark gap separates the wire from the earth as the coatings of a condenser are separated, and when charged the wire and ground act as a condenser. The lines of force then radiate symmetrically in all directions from one plate to the other. When a spark occurs at the gap, the discharge causes a sudden oscillation of the electrons in the antenna and consequently an electro-magnetic wave. The time of this oscillation depends largely on the inductance and capacity of the system, which also determines the length of the wave. A consideration of these facts ought to throw some light on the problem of directive wireless telegraphy.

To those who have puzzled over the terms "elliptically polarized" and "circularly polarized" waves, it might be said in brief that they are produced by the electron moving in an ellipse or a circle, and if moving in a straight line plane, polarized waves are produced.

A more striking electrical phenomena, and one that is a visible reminder to many people of the marvelous forces of nature, is the *aurora.* Thanks to recent investigations of electrical discharges in gases, we are certain that the aurora is an electrical disturbance. By means of the spectroscope a number of gases have been identified as forming portions of this luminosity. The pink tint is due to the rare gas *neon,* and a yellow-greenish tinge represents *krypton.* Where the energy comes from, which is here represented, is not known. Lord Kelvin has shown mathematically that it cannot come from the sun, so it is likely due to some electro-magnetic disturbances of which we know nothing.

People are generally surprised when shown how much water power is wasted in the United States every day. If they could be shown how much electrical energy exists about us, which we have no means of harnessing, their amazement would know no bounds. Now that we have the wireless transmission of energy, the next step may be the similar transmission of power, or perhaps it will be the opening up of an entirely new field of possibilities, of which we are now totally ignorant. Whatever it may be we can rest assured that the future will surely surpass the past, and possibly all of our scientific conceptions will need remodeling. Already it has been suggested that one of the most familiar properties of matter, the property of mass, is probably due to electricity. That is, that inertia of matter is electrical inertia only. This follows in part from the fact that the mass which we give to an electron is really not a measured mass, but only a computed one which we know possesses the same inertia as such an electric charge does. Whether this would apply to the positive particle is yet an open question.

No one would say that the views of the present day are final, for something new

appears at every turn, and our older theories are changed and extended. The tendency now is towards a monistic view of natural phenomena. We have atomic views of both matter and energy and these we see in their details are drawing towards convergence. Just as the imaginative flights of Maxwell were realized later in practical achievements, so also may our present theories form the starting points for new developments in the practical world.

[*This is the Fifth paper of a series prepared especially for The Electrical Experimenter by Mr. Rusk.—Editor.*]

NEW CELL THAT RENEWS ITSELF FROM AIR.

It is reported from Austria that Dr. Just of Budapest, the chemist who invented the Wolfram lamp, has discovered an electric cell, with iron and carbon electrodes, whose electrolyte is composed of an organic substance which renews its vigor from the oxygen of the air in a short time. Electrodes, having a surface of 200 square centimeters, give a current of five to six amperes with 25-volt tension. One hundred watts was taken from one cell for four hours and the cell then had half an hour's rest, and it was found that its power was completely restored.

Walter L. Slichter, professor of electrical engineering at Columbia University, New York City, believes that if the reported discovery of an electric cell was really made the feat was remarkable, since the problem had been deemed well-nigh impossible of solution.

"This is a well-known problem," he says, "and many methods have been applied to solve it, but without success. It seems hardly credible that it could be solved in as simple a manner as the dispatch would indicate. Carbon contains energy which is not easily released by combining it with oxygen, as in all our furnaces. Unfortunately it is a passive substance at low temperature, and particularly in electrolytic cells. Iron also would give energy if combined with oxygen, but this is only a little less difficult than in the case of carbon.

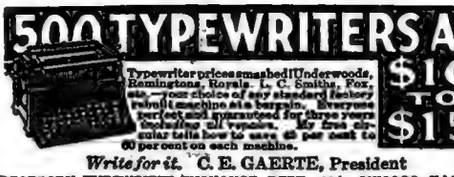
"If the organic substance referred to contains an acid which will consume iron we have the simple action of all primary batteries. If these were placed in series it would be possible to obtain 25 volts, but this would not be any cheaper method of getting energy than we have at present."

RADIOPHONES FOR SPAIN.

According to information recently published in the official organ of the Seville Chamber of Commerce, a company has been organized with a view to operating wireless-telephone systems in the different cities of Spain and to connect with the Spanish vessels and Spanish colonies in Africa.

The proposal contemplates the erection of stations in this consular district at the cities of Cordoba, Seville, Cadiz, and Huelva, and 29 other stations in other parts of Spain, in the Canary Islands, at Tangier, Melilla, Ceuta, and Ibiza, in Africa. It is hoped that connection can also be made with the vessels plying along the Spanish coast and, with the trains and the system, will, if possible, be connected with the regular urban and interurban telephone land lines.

It is stated that a company has been formed at Bilbao to install the lines and stations, and that the Spanish Government has been petitioned to authorize such a system.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Sensational Sales Successes

Two sales a day means $300 a month. Breeze, of Idaho, made $400 profit in 30 days. Rev. Otto Schulze, Mo., got $1600 to date. Burkholder, Mont., orders $1072 in 17 days. Hamilton, of Wyo., made $60 first two days. Hundreds like that. Pleasant, permanent, fascinating work. Write a postcard. Let me write you a long letter. No experience needed, no capital. Your credit is good if you mean business. But you must be ambitious, you must want to make money. That's all. Write a postcard now. I want to pay you $60 every week.

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21 BROMFIELD ST. BOSTON, MASS.

RADIO LEAGUE OF AMERICA NEWS.

(*Continued from page 97*)

causing interference we would immediately cut down our waves. We will not allow any member to use power enough to reach the coast under any conditions unless he either uses a short wave or else has a special license.

As to our loyalty to the United States, we hope that we are not less loyal than the most patriotic citizen in the whole land. We are planning to put our loyalty into practical use. We expect in the near future to form a volunteer signal corps and to practice field work under as near actual war conditions as possible. In the meantime we can be depended upon to discover and report any unneutral or unfriendly station which might attempt operation in this vicinity.

Hoping this may be of service to you. I beg to remain,

Very truly yours,
(Signed) FRANCIS F. MERRIAM.

We are pleased to publish also a description and photo of the "Rholphakapa" Radio Club, of East Liberty, Ohio. Mr. L. G. Lease, Dean, is in charge.

The "Rholphakapa" Radio Club was organized in December, 1915, by the students and the principal of the high school. The name is a combination of Greek letters, the meaning of which is known only to the members. The main station is located at the high school building. It is E. I. Co. equipped, except the phones, which are Brandes'. We have a 100-foot aerial, 35 feet high, suspended from the school building to a church. An 800-meter loose coupler with loading coil, silicon detector, 1½ inch spark coil and a "pancake" helix, etc., incorporated in the outfit.

Messages are picked up at most any time, although there are no stations within several miles. One of the members has his own station with 50-foot aerial, and several are preparing to put up stations. One member was absent when the picture of our station was taken.

Seated behind the table are, beginning at the left, Messrs. Chamberlain, Price, and Harshfield. Standing are Mr. Lane and the principal, Mr. Lease at the right. Mr. Green is at the phone. The club hopes to have each of the members equipped this summer. We will be pleased to hear from other wireless operators and radio societies.

DO YOU

own a wireless station, either for sending or receiving? If you do, don't fail to join the greatest Wireless Association in the country: THE RADIO LEAGUE OF AMERICA. If you believe in the preparedness of your country, if you wish to help Uncle Sam, if you wish to have your station **officially** recognized, join the LEAGUE, a national, non-money-making organization. Beautiful engraved and sealed certificate, FREE to all members. NO DUES OR FEES WHATSOEVER.

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Send stamp for large 8-page information booklet.

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WIRELESS TO JAPAN.

The Japanese Government has notified the Marconi Wireless Telegraph Company of America that the new wireless station at Funabashi, near Tokio, is completed and will be ready for transpacific communication soon. Experimental work between Honolulu and Funabashi is now going on, and the reports indicate that the system is working in splendid fashion at both terminals, which are separated by a distance of 3,400 miles. The Funabashi station is equipped with the Marconi apparatus, but is owned and operated by the Japanese Government.

The new government station at Funabashi is a 300-kilowatt plant, the same as the plant near San Francisco. There are two stations at Honolulu, each of 300 kilowatts, one facing east and the other west, one to send and the other to receive in the relay work either way.

It was said that when the new trans-Pacific service between Hawaii and Japan is opened to commercial business, the rates will be considerably lower than at present.

RAILROAD USES RADIO.

The Great Northern Railway Company is utilizing an ingenious device in the Cascade mountains wherein wireless apparatus is employed to bridge distances of one mile or less when wires fail. Communication was re-established recently when the tracks were blocked with numerous slides.

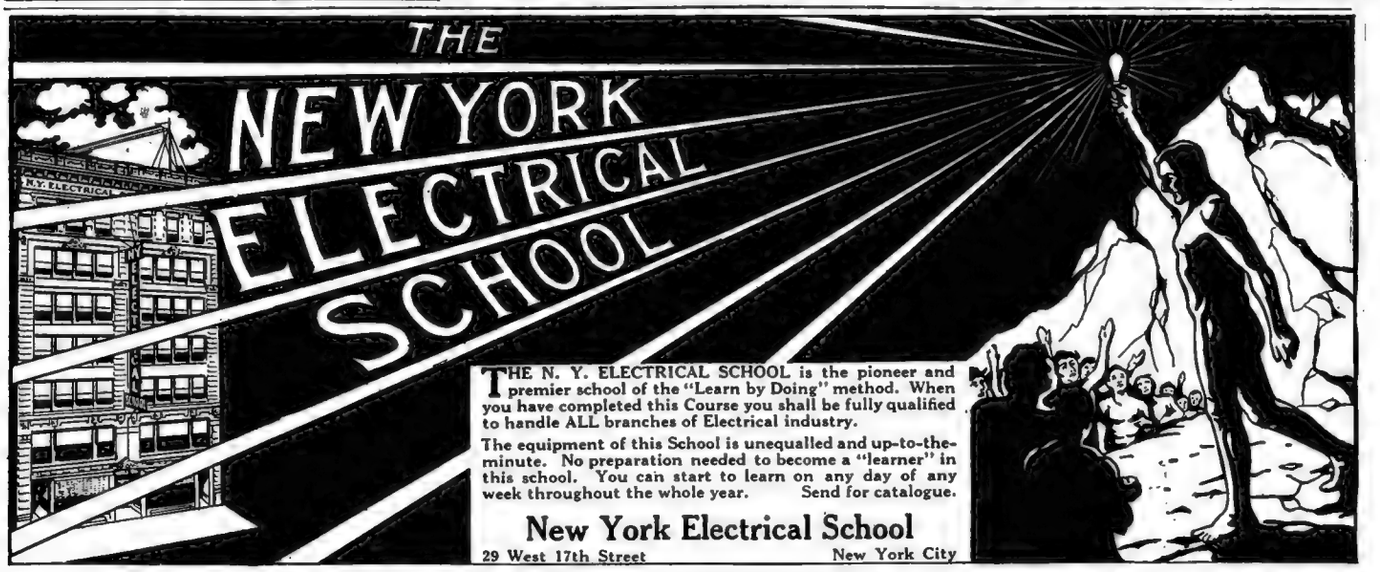
NEW WIRELESS SPEED RECORD.

A speed of 200 words a minute, said to be a record for wireless transmission, has been accomplished by the wireless station at the Great Lakes Naval Training School, North Chicago. The speed was obtained through the use of a transmitting relay and a recently invented automatic receptor.

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 93*)

ing by means of invisible rays, their bodies gyrating in a wonderful manner, darting hither and thither. Now they would enact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a charming sort of aërial ballet, next they would join hands and form a living wheel to rotate at a dizzy speed all over the house. They would dance, writhe, glide and perform the most unexpected and impossible aërial stunts, to the delight of the Martians. Finally, their bodies seemed to become transparent and suddenly they vanished from view entirely, not to come back. Here we had a realistic demonstration produced by unseen rays of how a body may become invisible in the fashion of our children's fairy tales. Altogether it was a very delightful performance.

"The next act, I am sorry to say, I cannot explain at all. Although our host tried to visualize it to us, we failed entirely to understand. To this minute I don't know what it was all about, but the Martians seemed to enjoy it hugely. As far as we could make it out, the Martians have a certain sixth sense, which we lack entirely, and for that reason the act in question produced no effect upon us.

"In the center of the arena there were placed three strange contrivances, with dazzling, scintillating balls suspended from metallic chains. The house was then darkened and three strangely garbed Martians with transparent rods would touch the balls at certain points in a certain (to us) queer fashion. I had never before seen a Martian laugh, but something or other must have aroused their risibilities, for I never had witnessed such uproarious laughter in all my life. They were convulsed, they shouted and hee-heed in their peculiar high falsetto voices that did one good. Even the otherwise stern, august Martian ruler shook with merriment. Our lacking sixth sense, however, prevented us entirely from enjoying the act. We neither felt nor saw anything in particular, aside from a somewhat faint tart taste at the tip of our tongue and an occasional very slight twitching of our face muscles. That was all.

"The following act was another 'musical' production, not in sounds, but in colors. 'Color-music' is, of course, known somewhat on earth already—the underlying idea being that certain colors correspond to certain fixed musical notes; thus it is claimed that C equals red, D is yellow, F-sharp blue, B-flat steel gray, and so forth. The Martians have long known this and have elaborated greatly on the original idea. They also found out early that certain notes are apt to produce certain *'tastes'* on the tongue. Thus one note may produce a slight sweetish taste and another one a tart taste. As color-music is supposed to give the same effect as sound-music both must act alike.

"The act in question resolved itself in 'music,' not to be heard, *but to be seen and tasted.* Paradoxical as this may seem, you would be surprised to know how well we, with our untrained faculties, understood and enjoyed this strange 'music.'

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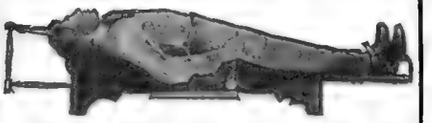

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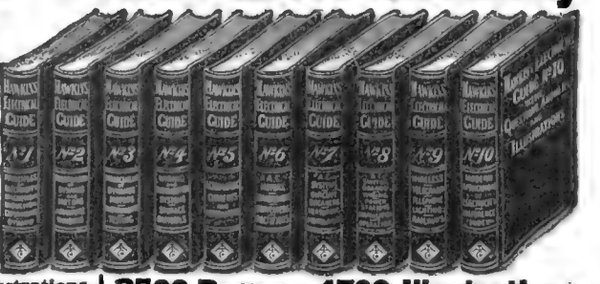

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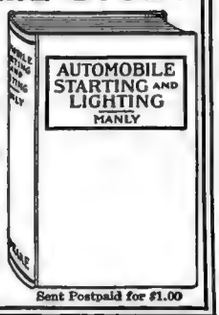

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"The colors which produced the effect seemed not unduly strong, on the contrary they were soft and very pleasing. They seemed to originate from nowhere in particular, but they enveloped every one in the house. The colors would melt from one into another, with seldom a sharp transition. Sometimes we would see one color right through another, then again the various colors would seem to chase one another, but at no time would we see beams or shafts of colored lights. The colors simply seemed to be all around us, they even seemed to permeate us. While we were enveloped in them, we could readily 'taste' each one distinctly, the most delightful experience being when there was a ripple of colors. This would produce a corresponding 'taste ripple' on the tongue, the taste varying from that of fresh hazelnuts to tart apricots. It is odd to relate, but most of the 'tastes' seemed to be those of fruits, only once in a while there was a steely or metallic taste, which always was prevalent when the 'music' assumed sombre 'tones.' During this performance, by some hidden electrical means, our bodies were kept a-tingling and aglow in a most remarkably delightful manner, producing a very pleasing effect of well-being, impossible to describe.

"The final act was a grand series of water plays. The arena floor was lowered and in so doing produced a gigantic tank which was filled to the top with water.

"It seems that as water is so exceedingly scarce on Mars, its inhabitants love nothing better than to gaze at the precious fluid. This is, of course, easily understood in a world which is slowly dying for lack of water.

"These water plays were almost entirely physical, but few performers taking part. By cutting off all external gravitation the water became naturally devoid of weight. Thus, if you scooped out a pail full and turned it upside down you could shake the water out, but it would not, of course, fall down, for there was no attraction below it. It would, therefore, hang freely in space like a cake of ice without falling apart.

"By means of the yellow emanation rays, of which I spoke already, the water could be pushed in any desired direction, up or down or sideways. By directing several rays in a certain manner the water would be made to rise like a water spout, but it kept its shape without dropping back to the tank. Thus wonderful water arches, rings, spirals, bridges, pyramids, etc., were created in rapid succession, to be followed by marvelous geometrical designs and all sorts of patterns. During the performance colored lights constantly played upon the water figures.

"Towards the end several clever Martians, propelled by unseen rays, built a delightful water palace about thirty feet up in the air. The palace itself was no mean structure, being about twenty feet or more in height. It was amazing how quickly these performers built the structure and how realistic it appeared, although being made of nothing but pure, though plastic water. When it was finished a myriad of colored light shafts were played upon it and a huge Tos rod began to emit the peculiar beautiful Martian strains of real sound-music. At that moment every Martian stood up and gazed intently at the water palace, which still hung freely suspended in space. Suddenly, without warning, the anti-gravitational power below was switched off and the palace became a shapeless form in a fraction of a second. With a loud splash the water—its weight now restored—dropped into the tank, sending a huge spray to all sides.

"The Martian 'show' was over. . . ."

* * * * * * * * * * *

It seems that the Baron's sending plant on the moon must have been full to capacity. At any rate I missed his usual goodbye. I am beginning to feel peeved that his daily reports are so short and always stop so abruptly.

SYNOPSIS

I. M. Aller, an eccentric young scientist of Yankton, Mass., who claims as his own many new as well as startling inventions, far ahead of anything as yet discovered, owns the largest radio-telephone plant in the country. One evening he hears strange noises over his phones and immediately a sepulchral voice is heard. It is Münchhausen, one of the greatest yarn and story tellers of all times. Münchhausen explains how it came about that he did not die in 1797, as popularly thought, and he furthermore gives unrefutable proof that his home is on the moon at present.

Aller wants to know why Münchhausen went to the Moon and how. The latter then explains how Prussia persecuted him and how he went over to the Allies and succeeded in capturing Berlin in a wonderful manner. However, it was not a complete success, so the Baron left Europe for America. He immediately constructs a machine which is to take him into space to the moon. Münchhausen has discovered how to neutralize Gravity by means of Electricity, and he applies this invention to his space flyer, the "*Interstellar*." The machine proves a success; it responds and is lifted with tremendous speed towards the moon.

Queer things are discovered on the way to the Moon, among others that bodies lose all their weight inside of the "*Interstellar*." Finally a landing is effected on the Moon in a desert, but great hardship is encountered on account of the Moon's rarefied atmosphere. The party then leaves for the nearest mountain range, where they discover a huge subterranean cave and a lake filled with luminous fish. Bread trees are also discovered. Münchhausen next gives a vivid description of the Earth, Sun and the firmament as viewed from the Moon; he also explains how the continents and oceans of the Earth appear from the Moon. He then tells of the ponderous meteors which continually crash down on the Moon. Finally one falls down near him and the resulting concussion hurls Münchhausen in a bottomless crater, which goes straight through the Moon. He falls clear through to the other side, but his momentum brings him back to the starting point, where he is saved by his companion. They then decide to depart for the Planet Mars, but they leave behind them an automatic Wireless Plant, the "Radiotomatic," which will relay the messages from Mars to the Moon and thence to Aller. A popular lecture on Mars is also given by Münchhausen.

Within 36 days they arrive at Mars, but when they attempt to land, three floating forts capture the "Interstellar" by means of a yellow ray which benumbs them, and guides the "Interstellar" to the Planet Ruler's revolving mansion where a landing is effected. Flitterpix speculates on the probable appearance of the Martians and gives his reasons on which he bases his assumption. Immediately after landing, the Martians place soft metallic caps on the travelers' heads, and they are then conducted to the Ruler's mansion.

They are conducted to the Planet Ruler's mansion and are taught thought transference as the Martians do not talk. Afterwards they are taken to one of the "Canals" and they are shown how the Sun's energy moves its waters. Later they are given an exhibition how intelligence is sent, no letters being used on Mars.

In the afternoon the visitors are shown a close view of the stupendous Martian cities, elevated over 500 feet in the air, to escape the choking Martian desert dust which prevails near the ground. They view the immense transparent buildings and are shown many other wonders.

Later they are shown a marvelous telescopic instrument and by its means they are enabled to see not only a close view of all the planets, but of the earth as well. They see the city of New York as clearly as if they had been on top of a skyscraper looking down into the streets.

This story started in the May, 1915, issue. Back numbers will be supplied at 10c. each postpaid.

Ah! here's a good idea. Guess I'll be "short" on the Editor once and stop abruptly. Under his contract he will have to pay me the full rate for the last word anyw. . . .

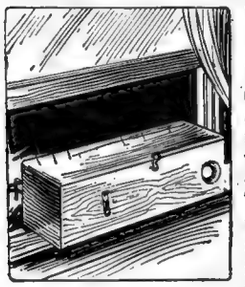
(To be Continued)

20,000 LIFTS IN MANHATTAN.

In the Borough of Manhattan there are roughly 10,000 passenger elevators and about the same number used for freight. Of the passenger type one-half, or 5,000 are in buildings of 10 stories and over. About 85 per cent of all new machines are electrically driven.

NEW ELECTRIC RAIN ALARM.

The electric Rain Alarm here illustrated is placed on the window sill at night when the window is left open for ventilating purposes. It consists of a box containing a battery, a buzzer, a small electric light, and a switching arrangement that holds what the makers call a *Raino-disc*. The falling rain, which is likely at any time to drive into the room and damage furnishings, drops on this disc, switches on the current, and throws both light and buzzer into circuit. The buzzer awakens the sleeper, and the light shows which window needs attention.



The latest form of this device has the *Raino-disc* on top of the box instead of at the back. This new arrangement arouses the sleeper only when the rain is actually driving into the room, thus avoiding false alarms.

AN ELECTRICALLY TIMED BANQUET.

"We have with us to-night," was a tabooed phrase at a farewell banquet tendered Guy L. Bayley and L. F. Leurey at a San Francisco cafe by mechanical and electrical engineers of the Panama-Pacific Exposition. Toastmaster J. Fitzsimmons instead notified the speakers when to talk by electricity. Each speaker, when his turn came, "felt" the inspiration to speak. The inspiration was directed by an electric battery and spark coil. Every chair about the table was wired in an electric circuit, with the switchboard at the toastmaster's plate and the speakers arose hurriedly. The event was what might have been termed a genuine Quaker gathering, with the participants in action when the "spirit moved" them.

COPPER OXIDE ACTS LIKE SELENIUM.

Selenium has long attracted considerable attention because of the peculiar effect light exerts on its electrical conductivity. Scientists have now discovered that copper oxide has properties similar to selenium. Another mineral recently put in the same class is stibnite, an antimony mineral. Sulphur, shellac, paraffin, and anthracene, a coal-tar product, will also exhibit odd conductivity effects under the influence of light, but to a lesser degree.

The French government is encouraging experiments with a device to protect against hail; essentially a large lightning rod of pure copper, which is said to so affect atmospheric electricity that hailstones cannot form. In some parts of the country such violent hail-storms sometimes occur that much damage is done to the farmers crops and vineyards.

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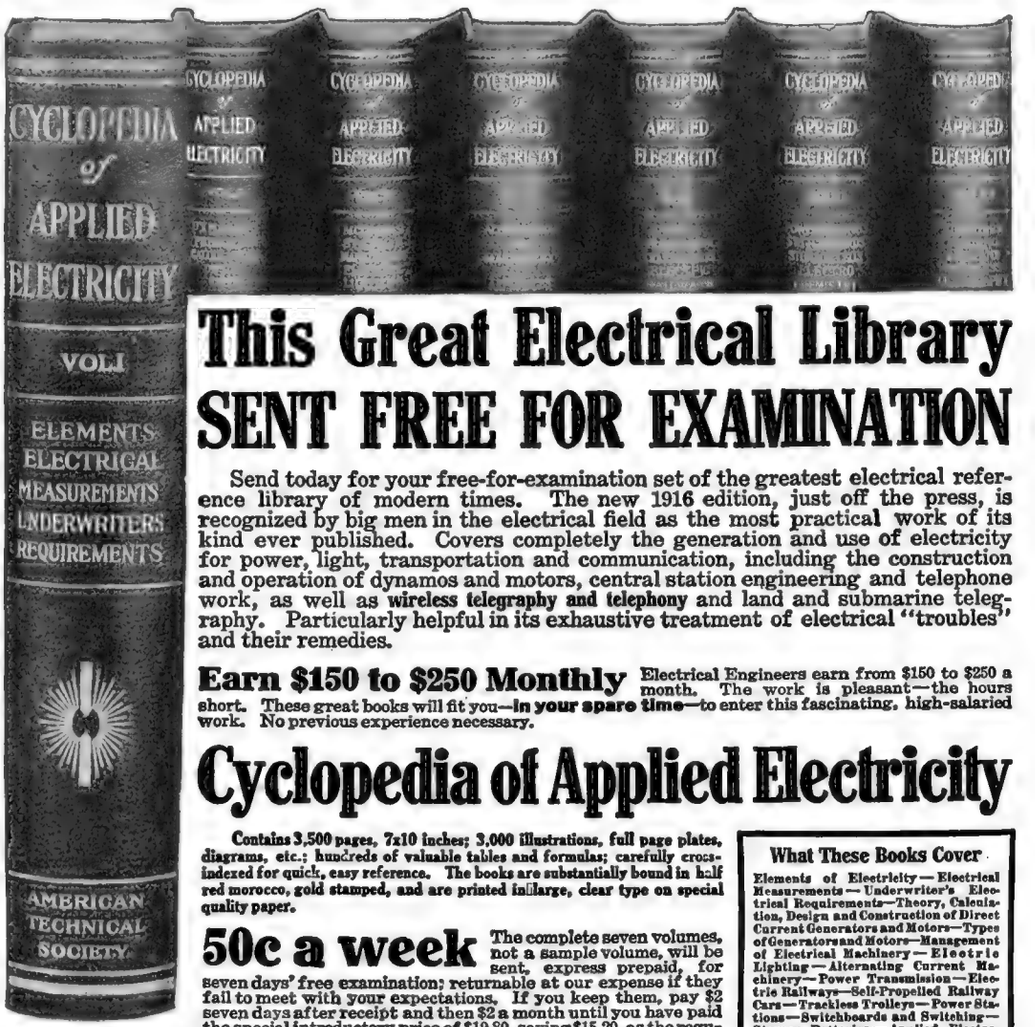

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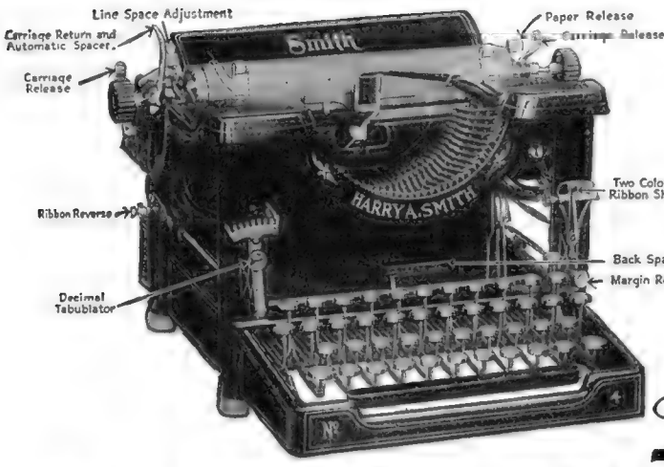

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WIRE DATA.

In calculating wire sizes for different purposes, there are several rules which if followed will facilitate the work.

1. A circular mil is the area of a circle .001" in diameter. To find the circular mils in the cross-section of a wire, square the diameter of the wire, expressed in mils (1 mil=1 thousandth of an inch).

2. Since the resistance varies as the cross-sectional area, to double the resistance, a wire is chosen having one-half the circular mils—not one-half the diameter.

3. The Brown and Sharpe wire gauge is the standard one for electrical conductors, also brass, aluminum and copper sheet.

4. To double the resistance, or find a size of wire having one-half the circular mils area of a given conductor, add 3 sizes to the gauge of the given wire. To find the gauge of a wire having twice the circular mils area, or one-half the resistance, subtract 3 from the gauge number of the given wire

5. The ratio of the circular mils area of a wire to the area of one the next size larger is 1.26 to 1.

6. A number 10 wire is practically .1" in diameter and has a resistance of 1 ohm per 1000 feet.

LIGHT LAMPS BY WIRELESS.

Apparatus by which gas lamps can be lighted and extinguished by wireless waves has been invented in Germany it is said. The apparatus utilizes a coherer presumably.

TESLA'S EARLY WORK WITH RADIO CONTROLLED VESSELS.

(*Continued from page 89*)

any source of electrical disturbance or oscillations, the generation of which is controlled by a suitable switch at T. The handle of the switch is movable in one direction only and stops on four points t, t', u and u', so that as the handle passes from stop to stop, oscillations are produced by the source during a very short time interval. There are thus produced four etheric wave disturbances during one revolution and the receiving-circuit is affected four times: but it will be understood from the foregoing description of the controlling devices on this vessel that the rudder will be moved twice, once to right and once to left. Preferably the handle of the switch is placed so that when it is arrested on points t t' that is to the right or left of the operator—he is reminded that the vessel is being deflected to the right or left from its course, by which means the control is naturally facilitated. The normal positions of the handle are therefore at u u' when the rudder is not acted upon, and it remains on the points u u' only so long as necessary. Since, as before stated, the working of the apparatus is quite sure, the operator is enabled to perform any such operations as provision is made for, *without even seeing the vessel.*

The manner of using the apparatus and the operation of the several component parts comprising the same is in detail as follows: Normally the plate L' is turned so that brush 2 rests upon the insulated segment 23 and brush 6 upon one of the insulated short segments in the rear of the circle. Under these conditions the rudder will be turned to starboard and the circuit of the propelling motor D interrupted between brushes 5 and 6. At the same time only one of the circuits of motor F—that

controlled by relay K'—is capable of being closed, since brush 2, which connects with the other, is out of contact with the long segment 21.

Assuming now that it is desired to start the vessel and direct it to a given point, the handle T, at the transmitting station, is turned from its normal position on point u' to the point t on the switch-box. This sends out an electrical (etheric) disturbance, which, passing through the receiving-circuit on the vessel affects the sensitive device A' and starts the flow of current through the local circuit, including said device, the relay a, and the battery a'. This, as has been previously explained, turns the cylinder j and causes the brush J' to pass from an insulation space to the contact j'. The battery K" is thus closed through relay K" and the latter closes that circuit of the motor F which, starting from plate 22 (which is permanently connected with one pole of the main battery) is completed through the brush 1, the field of motor F, wire 19, the armature of relay K", wire 16, the motor m, the brushes and commutator of motor F and wire 15 to the opposite terminal of the battery D. Motor F is thus set in operation to shift the rudder to port; but the movement of plate L' which follows, brings the brush 6 back onto segment 8 and closes the circuit of the propelling-motor which starts the vessel. The motor F is permitted to run until the rudder has been turned sufficiently to steer the vessel in the desired direction, when the transmitter handle T is turned to the point u. This produces another action of the relay a and brush J' is shifted to the insulation and both relays K' and K" are inactive. The rudder remains in the position to which it has been shifted by the motor F. If it be then desired to shift it to "starboard," or in the *opposite direction* to that in which it was last moved, the handle T is simply turned to point t' and allowed to remain there until the motor F which is now operated by relay K', the circuit of which is closed by strip J' coming into contact with plate j", has done its work. The movement of handle T to the next point throws out both relays K' and K", and the next movement causes a shifting of the rudder to "port," and so on.

Suppose, however, that after the rudder has been set at any angle to its centre position, it be desired to shift it still farther in the *same direction*. In such case the handle is moved quickly over two points, so that the circuit which would move the rudder in the opposite direction is closed for too short a time interval to produce an appreciable effect and is allowed to rest on the third point until the rudder is shifted to the desired position, when the handle is moved to the next point, which again throws out both relays K' and K". It will be understood that if the handle T be held for a sufficiently long time upon either point t or t', the motor F will simply turn the plate L' in one direction or the other until the circuits of motors D and F are both broken. It is furthermore evident that one relay K' or K" will always be operative to start the motor F.

As previously explained, the longest period of operation of which the motor F is capable, under ordinary conditions of use, does not permit the motor m to shift the arm m' into contact with the plate n; but if the handle T be turned with a *certain rapidity, then a series of current impulses* will be directed through motor m; but as these tend to rotate the motor F in opposite directions they do not sensibly affect the latter, but act to rotate the motor m against the force of the coiled spring m'.

This invention will prove useful in many ways, says Tesla. Vessels or vehicles of any suitable kind may be used, as life, despatch or pilot boats or the like, or for carrying letters, packages, provisions, instruments, objects, or materials of any description for establishing communication with inaccessible regions and exploring the conditions existing in them, for killing or capturing whales or other animals of the sea, and for many other scientific, engineering or commercial purposes, but it could also be used in warfare, for by its certain and unlimited destructiveness it will tend to bring about and maintain permanent peace among nations.

On the contrary, however, this invention has not been commercially exploited, and Tesla's dreams are so far unrealized.

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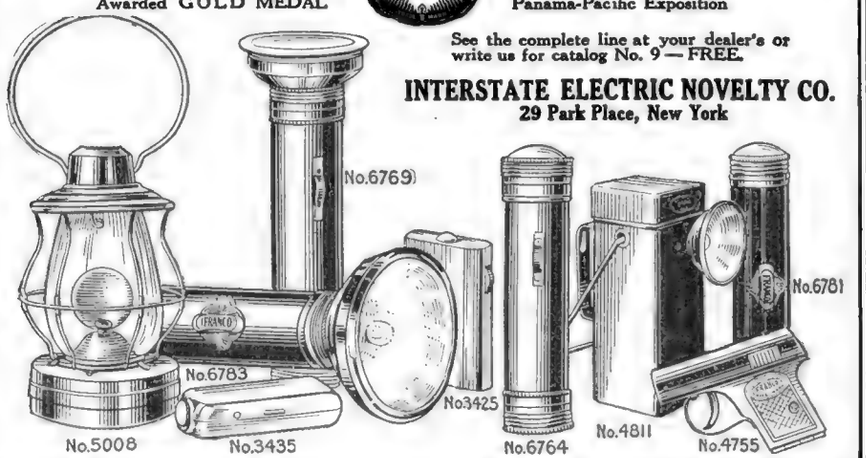

[*Experimenters will be interested to know that the patent on this invention has run out and any improvements which they may make on the different parts of the device may be patented without fear of prosecution for infringement.—Editorial Note.*]

MIMIC ATOMS AND THEIR EXPERIMENTAL FORMATION.

(*Continued from page 95*)

evenly at the edge of c and just on the edges of b and d, at either side of c. These two heavy cords will serve as a backing for the edges of the first few layers of magnet wire wound in c.

Fig. 2. Place the bobbin of magnet wire on the spool post of a sewing machine or on any convenient spindle. Put the kettle on a piece of newspaper, j, on a table. Allow about eighteen inches of wire for a lead and wrap this first, a turn or two, around the knot in the cord at the bottom edge of b; and then wrap the rest of the lead, g, out of the way around the handle lug of the kettle.

Begin to wind the coil, e, Fig. 3, in the space, c, by turning the kettle with the left hand while the wire, f, is guided with the right. The coil is wound with 370 turns in 16 layers of 23 turns each. At intervals of four layers it will be necessary to wrap one thickness of tape around the coil to insure an even winding. Do not let the *end turns* of a layer slip down over the edge. Whenever necessary build up an edge to wind against by melting sealing wax on both top and bottom all around the coil. The sealing wax stick, i, and the red hot poker, h, show this operation, Fig. 2. Break away the little driblets of wax that run over on the coil face. After about the first six layers it is well to bind the coil with ⅓ rd or eight of the twine ends, a; and then again after four layers with another ⅓ rd; reserving the remaining eight twine ends for binding the completed coil. *Be most careful not to break the wire at any time.*

Fig. 3. The coil is completed. Srewdriver, k, applied very carefully on both edges, chips away the wax adhering to the kettle and gently pries the coil loose from the kettle without breaking any strand of wire. With both hands, l, gently and evenly push the coil down at all points until it slips off. The coil is now securely bound with additional wrappings of twine or thread.

Fig. 4. Melt the paraffin in the bread pan, m. Have the wax at boiling point. Thoroughly wax coil, e, handling it while hot with old gloves or cloth pads. The coil will lose its shape, become flexible and droop in the hands.

Fig. 5. Put the coil while still hot over a wash basin, n, so that it will hold its proper shape while cooling.

Fig. 6 details the finishing stages; e is the coil as received from operation detailed in Fig. 5. O, first wrapping of cotton cloth and p, second wrapping; q, 6 inches of slack in the lead, g, wound noninductively around coil. Cover q with a short wrapping of cloth. In case g should at sometime break, q will be available for repair. At r is an armor of wrapping cord or marline. S, method of looping and knotting the cord; t, method of making a cord-armored lead-out; g, leads of the coil. When this is all done, immerse the coil again in paraffin, but not very long, and if necessary put over the wash basin in Fig. 5 for final cooling and shaping. When cool the coil will hold its shape and will be *waterproof.*

Figs. 7 to 15 illustrate the several stages in making and magnetizing the floating magnets.

Fig. 7. A, the magazine-pencil with pencil removed. Use flat file, b, to make brass tube end flat. Fig. 8. Use triangular file, c,

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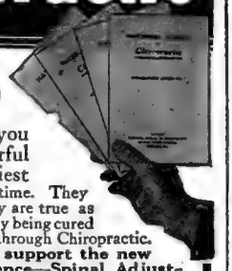

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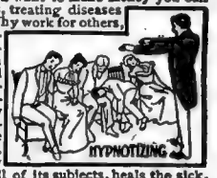

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to cut several notches in filed end of a, and bevel down the brass to a cutting-edge. The result is a perfectly good home made cork-borer.

Fig. 9. The cork-borer, a, is applied to the cork, d; a must be continuously turned while pressed into d. Fig. 10. The pencil, e, pushes the cork cylinder, f, out of a. Fig. 11. The safety-razor blade, h, is used to cut cork disks, g, off of f. Each disk must be ⅛ inch thick, smooth, and well made.

Fig. 12. The sewing-needles, l, are individually magnetized by stroking them over the edges of the poles, k and j, of the magnet, i, in the manner shown. The needle is stroked from center to point over the negative pole, k, and from center to head over the positive pole, j. This will make the point of the needle a positive or north-seeking pole and the head a negative or south-seeking pole.

Cheap magnets do not come with their poles already marked. If one does not care for added nicety he may arbitrarily mark them, but it is best to determine the true polarity by magnetizing a needle; swinging it in a thread stirrup as shown in Fig. 13; noting which end of the needle swings to the north; then magnetizing another needle in the manner shown in Fig. 12. The point of the second magnetized needle should repel the north-seeking end of the swinging needle. If not, turn the magnet over, so that k and j exchange places; make another test, which will come out right; then mark the new k pole with a negative sign and the new j pole with a positive sign.

Fig. 14 shows the finished needle magnet floating on the surface of the water which is cut away in section. The point of the needle, l, has been thrust through the center of the cork disk, g, so that the needle point just barely protrudes through the upper face of the cork, the needle hanging down perfectly straight. Fifty floating magnets are made from the two packages of sewing-needles and care should be taken that they are all *magnetized uniformly and in the same direction.* They may be kept in a tin box or on a piece of "tin" or sheet iron. Handle magnets carefully and keep them apart.

Fig. 15 shows how the floating magnet is remagnetized without removing its cork disk. For best effect a floating magnet should be remagnetized every time it is used.

Fig. 16 shows all of the apparatus set up for experiment. The coil is supported by the fruit jar covers. The water just covers the coil. The floating magnets are dropped into the water inside of the coil. If the battery current is in the right direction the floating magnets will be very visibly urged away from the coil and toward its center. If this does not occur, reverse the leads to the battery. One, two or three dry cells in series will be sufficient; a greater number of cells being used for *smaller* groups and fewer cells for *larger* groups.

The resistance of the coil is about 44 ohms. Three dry cells will pass through that resistance 1/10th ampere, a very small load upon the battery. Since there are 370 turns of wire in the coil, there are 370 times 1/10th, equals 37 ampere turns of magnetomotive force acting in the coil's magnetic field.

Let the experimenter try the effects of adding more or fewer cells in the battery on different groups—of trying different numbers of floating magnets in the groups—of raising the coil partially out of the water—of tilting it at an angle—of turning it upside down to reverse its polarity, etc., and he will learn for himself the rôle played by each individual part of the apparatus, and will be occupied for days with

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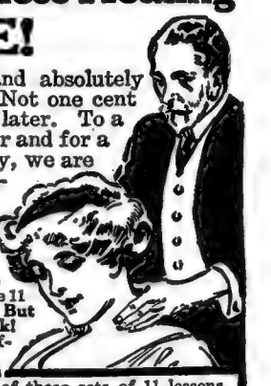

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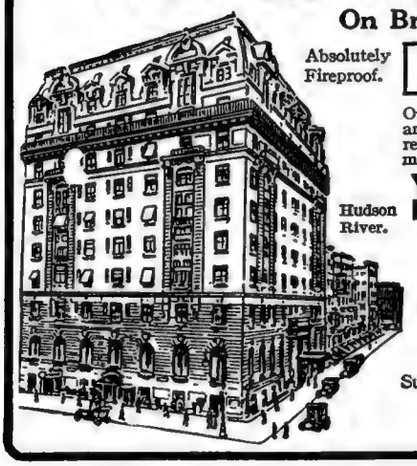

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Study the groups as they form and watch how the little magnets move unerringly into their allotted positions, propelled by unseen forces. Try to understand how all of the changing magnetic repulsive forces push this way and that against one another until finally they settle into a perfect balance or equilibrium, and the group comes to rest in the geometric configuration seen. How intricate is the interaction of these forces may be the more appreciated from the fact that the author worked several months on mathematically following up the course of a group of three magnets (or rather a general case of three repelling bodies) in seeking its triangular configuration of equilibrium.

The almost uncanny and all but intelligent way in which these little actors go about to choose their proper positions in a geometric scheme is wonderful to look upon, but more wonderful still is the significance which their arrangements have for the unravelling of the mystery of the atom. In the next paper we will learn something about this point more in detail.

(*To be continued*)

THE WIRELESS WIZ PLAYS WAR LORD.

(*Continued from page 91*)

We had the message, that is all there was to it.

The discussion was at its height, the four of us surrounded by the other members and strangely the "Wiz" seemed to be the most insistent in his questions. In the midst of the discussion all arguments ceased abruptly as a dull report reached our ears—

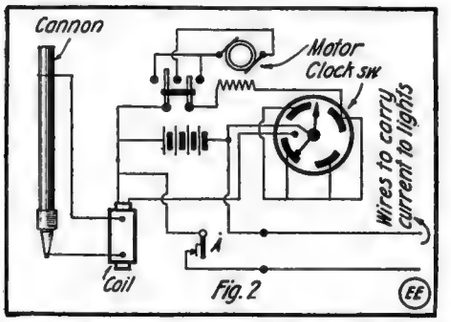

Diagram of Apparatus and Connections for Phantom Airship.

a sound not unlike the discharge of a large cannon. In our overwrought condition of mind our thoughts immediately flew to the wireless message we had copied and more than one looked scared.

Several of those gathered flew to the window and looked out into the night, only to recoil as if in horror. "Look!" one of them gasped, "there is one of the raiders now." We rushed to the windows and there, silhouetted against the dark sky, was a massive airship. It appeared to be about a mile away and was moving slowly across a gap between a tree and the next house and passed beyond the range of our vision.

It appeared not unlike the Zeppelins that are raising havoc on the British coast and a

light flashed now and then as if they were signaling.

A species of fear riveted us to the spot and with bated breath we watched for its reappearance and in about ten minutes it came slowly back, the light flashing, and then disappeared entirely.

Again the room buzzed with excited talk and we looked helplessly at the "Wiz" as if he was the only human being alive who could save the country in such a serious crisis.

"I tell you, fellows, what I'll do," he offered as if to demonstrate his power. "I can get a fast car around here in fifteen minutes, if the airship shows up again some of us will run out there and maybe be of service to the government. I'll bring along a rifle and you others get any small arms you may have access to." He went to the phone and called up a friend at a nearby garage and a few minutes later a big auto was panting before the door. Those who had weapons piled in and quick runs were made to their respective houses. Within a half hour quite a vigilant committee was gathered. The arms were distributed and all was ready for the showdown. The car with high gear in stood by the curb, rifles were loaded and a watch placed at the windows to await the raider.

It was fully half an hour before it showed itself and our half-frightened crowd of heroes rushed for the car. A crash and they were off, their goodbys drowned in the roar of the open cutout.

The "Wiz" of course was in that car, playing the leader, and they had no more than turned the corner when he ordered a halt for no airship could be seen. More mystery. But a few moments before it had been sailing serenely across the sky; now all was quiet.

"Let us go back again and find out if it dropped," he ordered. "It will only take a few seconds." So back they came, rushed into the clubroom and were reassured that it had not fallen, in fact was still in the air. They looked out of the window and behold! its large bulk was still showing against the dark sky like a dark cloud of disaster.

It is necessary to censor the remarks made the next few moments. There was the raider clear as day, yet when we went around the corner it was gone. It was bordering on the miraculous.

The "Wiz" seemed lost in thought and we looked forward to him unraveling the mystery. "I have it," he suddenly remarked. "Now watch the airship closely and you will note," he continued, as we all returned to the window, with the "Wiz" at our back, "that it is——"

Suddenly the whole yard was lit up, revealing the truth. Again, dear reader, we censor the remarks, as our eyes took in the whole arrangement of a cardboard airship strung on fine wire but a few feet from the window. We sprang around just in time to see the "Wiz" standing in the door convulsed with laughter. His ha-ha grated on our ears as he fled down the stairs three steps at a time with us in hot pursuit.

But, alas, that car was still in "high" and he got away on the jump; above the roar of its exhaust came that same triumphant laugh. To the tune of the flopping chains on the speeding car came those words—"He who laughs," etc., but why dwell on it—the memory is not sweet.

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We cooled our anger somewhat by ripping out the whole device and we quieted down somewhat in respect for the simplicity of the scheme he used in fooling us.

The airship was cut from heavy cardboard and slid over two fine steel wires supported at one end by a box fastened to the side of the house and a board fastened by means of heavy springs to the limb of a nearby tree. It moved parallel to the side of the club-house and about twenty feet distant. The box contained the apparatus for operating the airship, cannon and small lights.

A cheap alarm clock controlled the operation; the dial was fitted with five insulated contacts. Four of them were arranged so the minute hand would touch them; these were brass strips that covered a range of five minutes, the fifth was touched by the hour hand and closed the circuit that ignited the charge of powder in the cannon. The latter consisted of a length of gas pipe fitted with a spark plug as used in internal combustion engines.

A trip of the ship one way consumed five minutes and knots in the wire at the proper place served to throw the reversing switch which was connected to the small motor.

A wire running over pulleys and around the shaft of the motor served to move the model to and fro.

To flash the lights on the airship a pivoted lever, with a contact mounted on the rear, was arranged to rub against the moving wire. The wire moved it off the contact and held it open till gravitation overcame the friction and the contact closed again. This device operated regardless of the direction in which the belt traveled.

An ordinary arc light connected to the lighting circuit and controlled by a switch near the door was used to illuminate the scene.

The device was realistic to an extreme, and the effect was heightened by proper staging, being especially so in our case, due to the excitement of the moment.

Still the mystery of the fake wireless message was unsolved. The "Wiz" was no fool and knowing his great respect for the law I realized that he would not send a false message and thereby break his promise to conform to the Wireless Law.

It took me two weeks to get the "Wiz" cornered and admit his method and tell the world it was easy when explained.

It seems he had thrown a fine bare copper wire over my aerial and by using a buzzer and key he sent the message into my set. This also explained why I was unable to tune the message.

By these means had he made good his boast. As our friend Shakespeare was wont to remark: "There are more things in heaven and earth, Horatio, than are dream't of in your philosophy."

WHEN NEW YORK CITY TURNS ON THE JUICE.

(*Continued from page 80*)

and cabarets. Notwithstanding that the great metropolis has the reputation for staying up all night and going to sleep in the morning, such is not the case to any great degree as may be judged by the evidence here produced. Most of the good citizens are glad to trace their steps slumberward when the hour of twelve approaches, but as some of our hybrid story writers would prefer to have it, gaiety proceeds until 3 o'clock, when the lowest dip in the load curve appears and New York is asleep at last, *but only for one hour.*

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.

Required by the Act of Congress of Aug. 24, 1912, of THE ELECTRICAL EXPERIMENTER, published Monthly at New York, N.Y., for April 1, 1916:

State of New York, County of New York, ss. Before me, a Notary Public, in and for the State and County aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of THE ELECTRICAL EXPERIMENTER, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, to wit:

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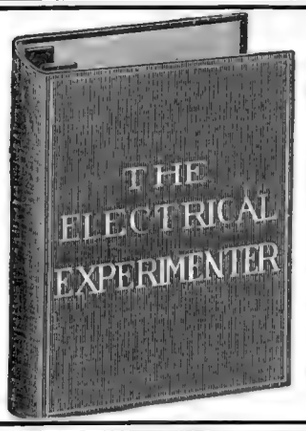
5. That the average number of copies of each issue of the publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is. (This information is required from daily publications only.)

H. GERNSBACK, *Editor.*

Sworn to and subscribed before me this 30th day of March, 1916.

[SEAL.] HENRY A. WALLENSTEIN,
Notary Public, New York County, No. 15.
(My commission expires March 31, 1917.)



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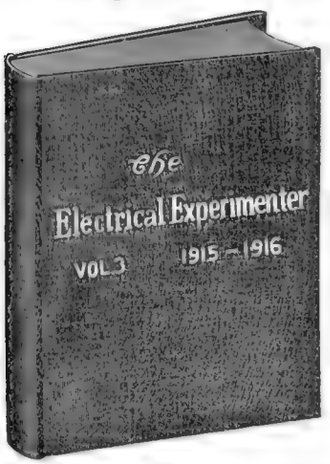

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AUDION DETECTOR—Mission cabinet, rubber front, inside rheostat, nickeled fittings, first $5.00 takes it with burned out bulb. Or $12.00 with new X-grade bulb and flashlights. Few new Audiotrons at $6.00 each. Washburn mandolin, fine condition, cost $25.00, sell $15.00 including case and music stand. W. Woodcock, 496 West Ferry St., Buffalo, N.Y.

FOR SALE—Portable receiving set, $4.00; 3 Exide storage cells, $2.00; pancake helix, $1.00. Wallace Peckham, Melville, Newport, R.I.

LOOK!—Government style omnigraph, never used, cost $16, only $10. Taps, fibre, contacts, machine screws, etc.; cheap. White for prices or trade. H. Semmelmeyer, 2629 N. Fairfield Ave., Chicago, Ill.

TO EXCHANGE—One 6 and one 12 volt 12 ampere brand new automobile generators, ball bearing. Thermo-pile with galvanometer. (A very interesting instrument.) 1/3 H.P. 3 phase induction motor, and several ⅛ H.P., D.C. and A.C. (single phase) motors. What have you to offer? Jos. Lamb, 563 Baldwin Ave., Detroit, Mich.

FOR SALE OR EXCHANGE—One Crescent concrete mixer on trucks; 2½ H.P. Novo Engine, 60 to 70 yards per day, steel engine house and all in fine shape, cost $325 new. Will exchange for screw cutting lathe, small A.C. motors or good "Ford." Gilbert McClure, 402 Dickinson Ave., Van Wert, Ohio.

ONE K.W. transmitting outfit complete, includes Marconi transformer, all A1 condition, first $60.00 takes it. Engraving machine, complete outfit, engraves anything, any person can operate. Value $100.00, sell for $25.00. No trades. Full description and photos for stamp to interested parties. F. G. Beck, 119 North Pennsylvania Ave., Greensburg, Pa.

TO TRADE—Electrical apparatus for a good stock saddle. Joseph Deines, Route 7, Topeka, Kansas.

FOR SALE—No. 2A Brownie 2½"x4¼" with portrait attachment, price $2.00. Ives electric train with tracks and 2 coaches, $2.00. One Vibroplex, $3.50. One telegraph key and sounder, $1.00. All articles in good shape. Emil Roth, Castle Shannon, Pa.

WATER MOTOR—$2.50; ground switch, $1.50; year American Boy, 50c. Charles L. Clapp, Uphams' Corner, Mass.

FOR SALE—Complete E.I. Co. Tesla outfit, including 2-in. spark coil, condensers, spark gap, Tesla coil, geissler tubes. It cost $20. E.I.Co. "Interstate" wireless reciving outfit, never used. Condenser and detector, $20. Telegraph Instructor with records and book; 15-jewel Elgin movement watch for $8; 4 volt battery motor; 50 Ohm relay. Everything new or in good condition. All letters answered. W. S. Hinegardner, Nokesville, Va.

GENUINE MAGGINA VIOLIN—About 120 years old, sweet sonorous tone, good condition, $95, or trade for twin motorcycle. Herman Banning, Canton, Okla.

FOR SALE—$75 International Correspondence Course books in electric lighting and railways, $12, film 5c. a foot, new 110 volt 1/12 Horse Power alternating curent motor, $3. H. David, 711 South Kedzie Ave., Chicago, Ill.

WANTED—A 1½ inch Rayfield or Stromberg Carburetor. State year made, condition and price in first letter. S. H. Kenney, Jr., Waterville, Minn.

BARGAINS—Crystaloi detector, not used one month, $2.50. Blitzen key, costing $2, for $1; Beeko detector holder, $.60. Manhattan fixed condenser, $.25. Instruments positively new. Elmer Baier, 444 Seventh Ave., Brooklyn, N.Y.

FOR SALE—Rotary Converter one hundred ten volts direct current to eighty volts alternating 60 cycles. Price ten dollars. Also other apparatus for sale or exchange. Nangle, 630 Marion St., Oak Park, Ill.

FOR SALE—800 meter loose coupler, electrolytic detector, 2000 ohm phones, wireless key. For particulars write. Heber Lyons, R.D. No. 2, Sacramento, Calif.

SALE OR EXCHANGE—Spark Coil, Meccano sets, trains, good boy's books, motors, tool set, No. 20 wire, etc.; letters answered. Richard Jones, 985 Aldus St., Bronx, New York.

HAVE Electro receiving set No. 1603 and apparata. Will trade for Corona typewriter or audion. Inquiries answered. Albert G. Olson, 521 Ash St., Osage, Iowa.

FOR SALE OR EXCHANGE—Small wireless set, skates, sporting goods, boy's magazines, boy's books. Write Wm. Borough, 702 Jefferson Ave., Lawrenceville, Ill.

FOR SALE—¼ Kilowatt 110 volt to 12000 volt wireless transformer, 60 cycle current. Mahogany finish, new, $9.00 prepaid. Regular $15.00 value. O. C. Sutherland, 1829 Nevin Ave., Richmond, Cal.

TELEGRAPH box relay with key on base, also plain relay, both 150 ohms; want two-inch spark coil. C. E. West, Coyote, Calif.

FOR SALE—3000 meter loose coupler, $3; 1500 meter tuning coil, $1.50; 2 K.W. 110 volt D.C. generator, $50. Ralph Leffler, Tiffin, Ohio.

FOR SALE OR EXCHANGE—About 50 different articles, electrical, musical instruments, kodaks, pistols, etc. Write for list at once. F. J. Bretzke, Brownsville, Wis.

FOR SALE—2 K.W. transformer, $15; also long distance audion receiving set on Formica panel. Paul Flehr, Ironton, O.

HAVE racing bicycle, ¼ K.W. transformer, spark gap, telephone induction coil, wattmeter, plate camera, 500 feet movie film, enameled wire, technical and electrical books. Want anything of value. Will exchange separately. All letters answered. Theodore Getzler, 60 East 120th St., New York City.

FOR EXCHANGE—Lyon & Healy Professional cornet in leather plush lined case. Value $50. Want Audion and receiving cabinet, preferably Blitzen. Make offers. Have other articles for exchange. J. O. Huset, Huron, S.D.

FOR SALE—$3.50 Turney 35 plate variable condenser, $2; $6 type AA crystaloi dectector, $4; $5.50 omnigraph and records, $4; $5.50 Voltamp 12 volt 3 ampere generator, $4. Thomas Hicks, 425 West Miner St., West Chester, Pa.

NICHOL'S Navy coupler, $5.50; E.I. coupler, $1.50; Radioson, $2; Stereopticon, $18; Audio-Tron bulb, $6; 400 exposure kodak, 722; Halcun gap, $6; Johnson-Willard and Willard-Moran fight slides (40). Trades considered. Verner Hicks, Marion, Illinois.

FOR SALE—One $10 Electro 6-60 storage battery, new, $6.75; expressage to be paid by buyer. One $7.50 Loose Coupler, 3000 meters, slider on secondary very selective, $5. One $4 Commercial Relay brand new 150 ohm, $2.75. Articles in fine working order. Fred. Schussel, 702 Hudson St., Hoboken, N.J.

FOR SALE—Blitzen ¼ K.W. transformer mounted, $7; Murdock, $4; oscillation transformer $3; $5 Meccano, $2.50. Everything in perfect condition. Stuart Sandreuter, Havemeyer Road, Stamford, Conn.

FOR SALE—New No. 6 $10 Erector, for $7. New $4 aerial switch for $2.50. Freddie Silsbe, Prattsburgh, N.Y.

BARGAIN!—Must sell new wireless! 1½-in-spark coil, large helix, same as Electro 8271; Leyden jar, switches, fixed, fixed variable condensers, 36 switch-points, pound No. 24 wire, phones, rubber switch handles, etc. Write "Radio," 326 Clermont Ave., Brooklyn, N.Y.

I have twenty Alger books and a ten dollar set of "Model Builder," with about three dollars worth of accessories. Will sell for $5 cash. John Hoff, 712 Magnolia St., Toledo, Ohio.

$15 Murdock Loose coupler, new, $10. Howard Sorey, Newkirk, Okla.

FOR SALE—Wireless receiving set complete with Holtzer-Cabot, 3000 ohms Radio receivers with aerial and necessary switches. Mounted in cabinet with crystaloi Detector, type AA, cabinet size 24x12x9½; also 1-in. coil and spark gap. Worth $60. Everything new last November. Make offer; all letters answered. Richard Taylor, 141 Lake St, Winsted, Conn.

FOR SALE OR EXCHANGE—Double bass viol in good condition, construction book and bow; worth $15. Will exchange for good typewriter. Stephen R. Hardwick, Belmond, Iowa.

WILL sacrifice my perfect Clapp-Eastham one kilowatt transmitter complete for fifty dollars. Cost hundred and fifteen dollars. Harry Milburn, Highwood Terrace, Weehawken, New Jersey.
Donald, 1514 Arch St, Philadelphia, Pa.

WANTED—See April advertisement; also very large variable condenser, ohmmeter, graduated rheostat, wireless telephone apparatus, storage batteries, Koawood Ukelele, Columbia chainless bicycle, motion picture camera, also in exchange instantaneous electrical water heater. John MacDonald, 1514 Arch St., Philadelphia, Pa.

FOR SALE—Schmidt-Wilkes phones, hard rubber covered headband, aluminum shell, $4. Roy Bedbury, 757 4th St., Richmond, Calif.

WANTED—To exchange No. 6 Remington typewriter, good condition, for wireless receiving set of equal value. A. L. Oden, Muscadine, Ala.

ELECTRIC Therapeutic Apparatus, X-Ray 30", 1000 volts for sale, everything new. Will demonstrate any evening after 7.30 p.m. 364 W. 57th St., or Edw. Maxwell, 113 West 63rd St., N.Y.

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FOR SALE—1 Chambers coupler, $3; 1 Turney loading coil, $2; 1 Brandes receiver with headband, $1.25; 1 five mile transmitting set, $2.50; fixed condenser, 25c; undamped waver receiving machine, $4. Will sell all for $12.50 or separately. All in first class condition. Harold Van Loan, Athens, N. Y.

FOR DISPOSAL—Murdock $15 loose coupler and $3 and $4 variables. F. B. Holmes, Newton Highlands, Mass.

FOR EXCHANGE—One direct current 110 volt 8-inch electric fan, good condition, for one inch Bull Dog spark coil. A. D. Snell, St. Maurice, La.

FOR SALE—One Remington 22 cal. hammerless repeating rifle, good as new, First $10 takes it. Send for list of other goods for sale. Ingwald Wick, Hendrum, Minn.

EXCHANGE seven volumes of I.C.S. text books on Electrical Engineering for Bicycle with motor attachment or good bicycle with coaster brake, must be in first class condition, or motor attachment. These books are new and in first class condition. Roy L. Parsons, Laquey, Mo.

FOR SALE CHEAP—Wireless and electrical books, magazines, coils, switches, wire, raw material. Write for list or appointment. Wm. Graver, 60 W. 66th St., (care Nelson), N.Y.

2½ K.W. transmitting outfit complete, or 2½ K.W. transformer separate; sec. 20,000 v. variable 5-25 amperes. Make offer. Leonard J. Edick, 89 Forest St., Gloversville, N.Y.

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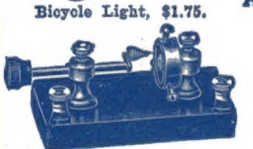

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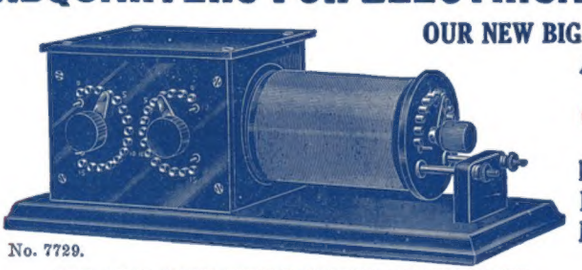

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